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# PRUDENT FOOD STORAGE: Questions & Answers

From the House at Cat's Green
Alan T. Hagan

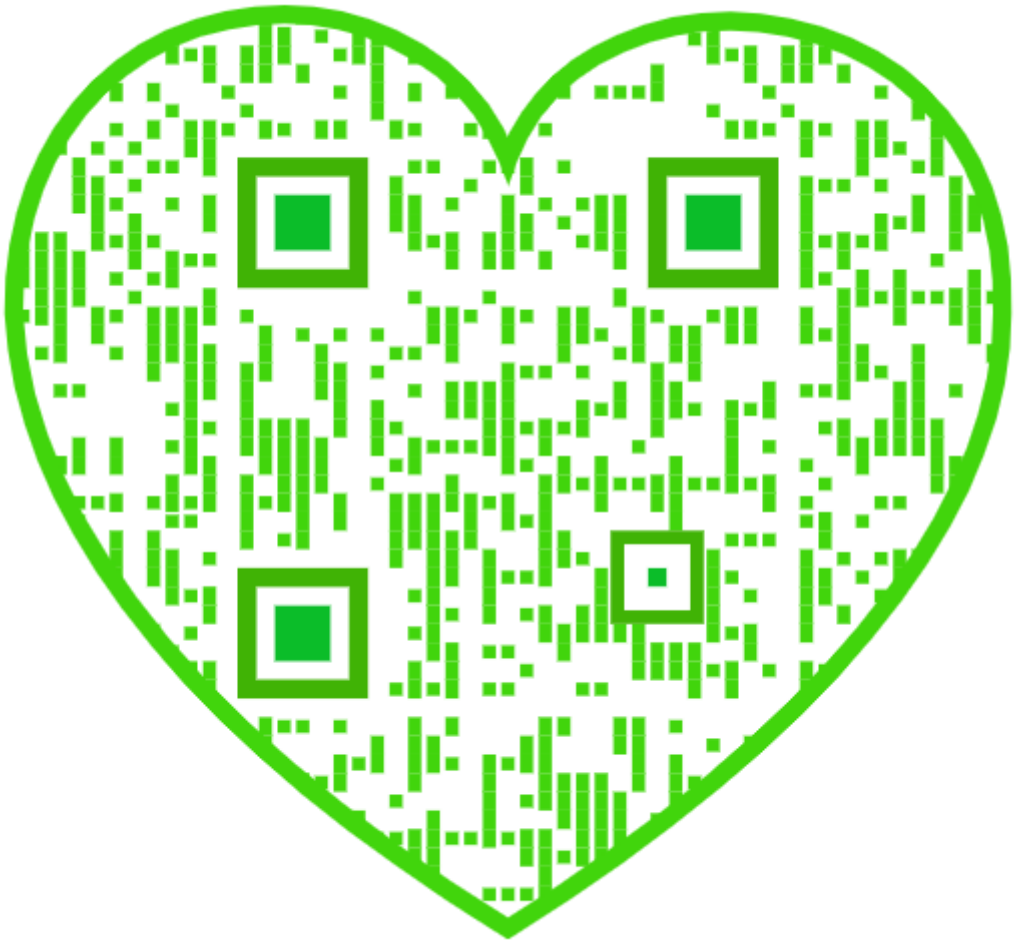
"In this work, when it shall be found that much is omitted,
let it not be forgotten that much likewise is performed."

Samuel Johnson, 1775, upon
completion of his dictionary.
Courtesy of James T. Stevens

********* SPECIAL NOTE ***** SPECIAL NOTE ***** SPECIAL NOTE ********

This Version 3.0 update of the Prudent Food Storage FAQ includes a first time event. An increasing number of people have been asking for a printed and bound copy of the FAQ, apparently as a response to the Year 2000 computer problem and other Millennial concerns. With the aid of my partner, Bob Hollingsworth, we have formatted, printed and bound Version 3.0 to honor these requests. Naturally, since we have spent a good deal of our time and a not inconsiderable amount of our cash in doing this we are not giving it away for free, but are charging $15.00 (US) per copy plus $3.00 shipping and handling (US Postal Service Priority Mail). My postal address may be found below and at the end of this file, or you may e-mail me.

This print edition will be available for only for a limited time. The reason for this is that I am presently at work on "The Prudent Pantry: Your Guide to Building A Food Insurance Program", my first commercial work. When completed it will contain all of the content of this FAQ plus a good deal more that I don't presently cover such as storage program planning, inventory control, storage locations, the best foods to store, grain mills & other equipment, water storage and purification along with expedient sanitation.



At this time I am not ready to give either a firm publication date or cover price for *The Prudent Pantry*, but I am hoping for early spring of 1999. When it is ready to go to press I will stop printing bound FAQ copies. Due to the ever growing size of the work (presently over 300k) I can no longer post the FAQ to the Usenet. I will, of course, continue to make the FAQ updates available online via host sites on the World Wide Web even after the book hits the street.

CARPE DIEM!

********* SPECIAL NOTE ***** SPECIAL NOTE ***** SPECIAL NOTE **********

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PLEASE DIRECT CONTRIBUTIONS, COMMENTS, QUESTIONS AND/OR CRITICISMS TO:
athagan@sprintmail.com

Orders or written material may be sent to the address below:

A.T. Hagan
P.O.Box 140008
Gainesville, FL  32614-0008

## FOREWORD

This work is a compilation of answers to frequently asked questions (FAQ) concerning long term food storage. Its purpose is to promote an understanding of the methods and techniques used to extend the nutritive and palatability shelf lives of those foods most suitable for use in food storage programs.

There is commonality between food storage and food preservation even though they are not precisely the same thing. Some of the information here may be found in greater or lesser detail in the *rec.food.preserving* (r.f.p) FAQ compiled by Leslie Basel. If you want the how-to's of drying fruit, making jerky, canning beans, fermenting pickles or corning beef, I refer you to her work and the good stuff to be found there.

In this compendium you will be taken through the ins and outs of how to put away your storage foods and have a reasonable expectation of getting something edible back out of the container when you finally use them. Also covered will be food spoilage -- how to recognize it and how to combat it. A resource list detailing where to find supplies and further information is included at the end.

This file is updated as sufficient material becomes available. Be of assistance -- point out mistakes, contribute data or information, write reviews, or provide us with new sources. As a contributor you will be cited in this file, unless you wish otherwise.

## TABLE OF CONTENTS

0. Acknowledgements, Foreword, and Table of Contents

I. Shelf Lives: Time, Temperature, Moisture, Oxygen and Light

II. The Techniques of Food Storage

- A. Grains and Legumes
  - 1. Grain Varieties
  - 2. Legume Varieties
  - 3. Types of Availability of Grains and Legumes
    - Moisture Content
    - Cleaning It Yourself
  - 4. Storing Grains and Legumes
- B. Dry Milks
  - 1. Types of Dry Milks
    - Buying Dry Milk Products
  - 2. Storing Dry Milks

- Shelf Life of Dry Milks

C. Canned Goods
1. Canned Milk Types
- Shelf Life of Canned Milks
2. Corrosion Prevention of Canned Goods

D. Sugar, Honey and Other Sweeteners
1. Types of Granulated Sugars
- Storing Granulated Sugars
2. Types of Honey
- Buying Honey
- Storing Honey
Raw Honey and Botulism
- Honey Outgassing
3. Types of Cane Syrups
- Storing Cane Syrups
4. Corn Syrup
5. Maple Syrup

E. Fats and Oils
1. Buying & Storing Oils and Fats
2. Extending Shelf Life By Adding Anti-Oxidants

F. Cooking Staples
1. Baking Powder
2. Baking Soda
3. Herbs & Spices
4. Salt
5. Vinegar
6. Yeast

G. Infant Formula

III. Spoilage

A. Insect Infestations
1. Pests of Stored Grains, Legumes and Dry Foodstuffs
2. Control of Insect Infestations

B. Molds In Foods
1. Minimizing Molds
2. Molds in Canned Goods
3. Molds in Grains and Legumes
- Preventing Molds In Grains and Legumes

C. Bacterial Spoilage
1. Botulism
2. Other Bacterial Spoilers of Food

D. Enzymatic Action In Food Spoilage

IV. Specific Equipment Questions

A. Storage Containers
1. What is Food Grade Packaging?
- Where Can I Find Food Grade Containers?
2. Plastic Packaging

- How Do I Get the Odor Out of Pickle Buckets?

3. Metal Cans
   - Pooling Resources: The Church Of Jesus Christ Of Latter Day Saints
4. Glass Jars
5. Mylar Bags
   - How Do I Use Mylar Bags?
6. Reusing Or Recycling Packaging

B. CO2 and Nitrogen
1. Dry Ice
   - Dry Ice Suppliers
2. Compressed Nitrogen
   - Types of Availability
   - Obtaining the Gas and Necessary Equipment
   - Putting It All Together
   - Putting It Into Use

C. Oxygen Absorbers
1. What Is An Oxygen Absorber?
2. Where Can I Find Oxygen Absorbers?
3. How Are Oxygen Absorbers Used?

D. Desiccants
1. What Is A Desiccant?
2. Types of Desiccants
   - Silica Gel
   - Clay Desiccant
   - Calcium Oxide
   - Calcium Sulfate
   - Other Desiccants
3. Where Do I Find Desiccants?
4. How Do I Use Desiccants?

E. Diatomaceous Earth
1. What Is Diatomaceous Earth?
2. Where Can I Find DE and What Type Should I Buy?
3. How Do I Use DE In Food Storage?

V. Shelf Lives

A. "Best Used By", "Use By" and Other Food Product Dates

B. Closed Dating Codes Used By Some Food Manufacturers

C. Shelf Lives of Some Common Storage Foods

VI. Resources

A. Books

B. Pamphlets

C. Magazines

D. Phone, voice, non-modem

E. Electronic-online

- Information sources
- Software sources

F. Organizations
1. The Church Of Jesus Christ of Latter Day Saints
- LDS Family Cannery Guidelines

G. Food and Equipment Suppliers
1 Mail Ordering Storage Foods What You Should Know
2 Addresses of Suppliers.
- Storage Food Manufacturers
- Food Preservation Dealers & Suppliers
- Food Storage & Preservation Equipment Manufacturers
- Diatomaceous Earth Manufacturers & Dealers
- Storage Food Retailers

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-- I --

## SHELF LIVES: TIME, TEMPERATURE, MOISTURE, OXYGEN AND LIGHT

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Is your food insurance up to date?

Since the entire idea of a food storage program is that it should be available for "you and yours" in times of need, it is important to understand the conditions that can affect the edibles stored in your pantry.

A storage program is only as good as the quality of the food that goes into it. It cannot get any better than what originally went in, but it can certainly get worse. In the fullness of time, all stored foods will degrade in nutrient content and palatability until they reach the inevitable end where even the dog won't eat them. It's because of this eventuality that every article, book, and teacher concerned with putting food by gives the same advice: *Date all food containers and rotate, Rotate, ROTATE. The first food in should be the first food out.* This concept is often shortened to the acronym FIFO.

The reason for this emphasis on stock rotation is that when discussing the usefulness of foodstuffs there are really two shelf lives to be considered. The first is the nutrient content of the food. This actually begins to fade at the moment of harvest. Three factors dictate nutritional shelf life: The food's initial nutritional content; the processing and preservation steps it underwent; and its storage conditions. Eventually the nutrition will dwindle away to nothing. At some point you will have to decide whether the remaining nutrition is worth the space the food is taking up and if it should be rotated out of storage.

The second shelf life is a food's palatability life or the point at which undesirable changes occur to its taste, texture, color and cooking qualities. This is the reason for the "use by" and "sell by" dates on many foods and for shelve lives in general. It will almost always be in excess of good nutritive life. If you don't have anything to replace it with, it's not necessary to throw food out just because it's reached the end of its best palatable storage life. Do, however, keep in mind that

advancing age will only further decrease the useful nutrition, increase the foods' unattractiveness and enlarge the chances that something may cause the food to spoil.

Within reason, the key to prolonging the shelf life of your edibles lies in lowering the temperature of the area they are stored in. The storage lives of most foods are cut in half by every increase of 18 deg. F (10 deg. Celsius). For example, if you've stored your food in a garage that has a temperature of 90 deg. F, you should expect a shelf life less than half of what could be obtained at room temperature (70 deg. F) this in turn is less than half the storage life that you could get if you kept them in your refrigerator at 40 deg. F. Your storage area should be located where the temperature can be kept above freezing (32 deg. F) and, if possible, below 72 deg. F.

Ideally, your storage location should have a humidity level of 15% or less, but unless you live in the desert it's not terribly likely you'll be able to achieve this. Regardless, moisture is not good for your stored edibles so you want to minimize it as much as possible. This can be done by several methods. The first is to keep the area air-conditioned and/or dehumidified during the humid times of the year. The second is to use packaging impervious to moisture and then to deal with the moisture trapped inside. If you are able, there's no reason not to use both.

All containers should be kept off the floor and out of direct contact from exterior walls to reduce the chances of condensation.

Another major threat to your food is oxygen. Chances are that if you have it sealed in moisture-proof containers then they are probably air-tight as well. This means that the oxygen can also be kept from doing its damage. If no more can get in, your only concern is the O2 that was trapped in the container when it was sealed. Lowering the percentage of O2 to 2% or less of the atmosphere trapped in the packaging (called head gas) can greatly contribute to extending its contents shelf life. The three main tactics for achieving this are vacuum sealing, flushing with inert gas or chemically absorbing the oxygen. Any one or a combination of the three can be used to good effect.

Once you have temperature, humidity and oxygen under control, it is then necessary to look at light. Light is a form of energy and when it shines on your stored foods long enough it transfers some of that energy to the food. This has the effect of degrading its nutritional content and appearance. Fat soluble vitamins, such as A, D and E are particularly sensitive to light degradation. It certainly is a pretty sight to look at rows and rows of jars full of delicious food, particularly if you were the one that put the food in those jars. However, if you want to keep them at their best, you'll admire them only when you turn the light on in the pantry to retrieve one. If you don't have a room that can be dedicated to this purpose then store the jars in the cardboard box they came in. This will protect them not only from light, but help to cushion them from shocks which might break a jar or cause it to lose its seal. For those of you in earthquake country, it's a particularly good idea. When "terra" is no longer "firma" your jars just might dance right off onto the floor.

Assuming they were properly processed in the first place, canned,

dried and frozen (never thawed) foods do not become unsafe when stored longer than the recommended time, but their nutrient quality fades and their flavor goes downhill. Following these rules of good storage will keep your food wholesome and nutritious for as long as possible:

#1 - First In, First Out (FIFO) means rotating your storage
#2 - Cooler is better
#3 - Drier is better
#4 - Less oxygen exposure means more shelf life.
#5 - Don't shed light on your food.

Think of rotating your food storage as paying your food insurance premiums -- slacking off on rotation cuts back on your coverage. Is your food insurance up to date?

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## -- II --
## THE TECHNIQUES OF FOOD STORAGE

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In this section will be covered a number of foods that are particularly suited to being included in storage programs along with the various forms they can be found in and specific tips for a number of different food categories.

### A. GRAINS AND LEGUMES

#### A.1 GRAIN VARIETIES

One of the most important decisions in planning a food storage program is what kinds of grains to include, but many people do not give this adequate thought. Some just buy however much wheat or corn or rice they think is necessary to meet their needs and leave it at that. Others rely on pre-packaged decisions made for them by their storage food retailer who put together a "year's supply of food" to buy all at once. Either decision could be a major mistake.

There are a number of food storage plans one may use as a guide. Many are based on the so-called "Mormon Four" of wheat, milk, honey and salt, with as many additional foods as the planner found to be desirable. When it was created in 1937, this plan may have been OK, but we've learned a great deal since then. An unfortunate number of people in our society develop allergies to one kind of food or another. One of the more common food allergens is wheat. Even more unfortunate is the fact that many people who have an allergy to wheat don't even know it. They won't become aware of it until they try to live with wheat as a large part of their diet. For this reason you should store what you eat and eat what you store, so that ugly surprises such as this don't come up when it's too late to easily avoid them.

A second reason to think about storing a selection of different grains is appetite fatigue. There are those who think providing variety in the diet is relatively unimportant and that if and when the time comes they'll eat what they've got and that will be that. For healthy, well-adjusted adults under ordinary circumstances this might be possible without too much difficulty. However, the entire reason for having a food storage program is for when circumstances aren't ordinary. Times

of crisis produce stress -- possibly physical, but always mental. If you are suddenly forced to eat a diet both alien and monotonous, it is going to add just that much more stress on top of what you are already dealing with. If your planning includes the elderly, young children and/or infants they might just quit eating or refuse to eat sufficient amounts and become unable to survive. This is not a trivial problem and should be given serious consideration. Consider the positive aspects of adding some comfort foods.

In his book, *Making the Best of Basics*, James Stevens mentions a post-WWII study by Dr. Norman Wright, of the British Food Ministry, which found that people in England and Europe were more likely to reject unfamiliar or distasteful foods during times of stress than under normal conditions. When it's wheat, day in and day out, wheat's going to start becoming distasteful fast. Far better to have a variety of foods on hand to forestall appetite fatigue and, more importantly, to use those storable foods in your everyday diet so that you'll be accustomed to them.

[If anyone knows where I may find an actual copy of the study by Dr. Wright, I'd appreciate it if you'd point me to it. Thanks- ed.]

ABOUT GLUTEN: As you read through the grains descriptions below you will come across frequent mention of "gluten". Gluten is the protein in grains that enables the dough made from them to trap the gasses produced by yeast fermentation or chemical reaction of baking powder or soda and in turn causes it to rise. The amount of this protein to be found in species of grains and varieties within a species can vary radically. Some grains such as rice have virtually no gluten at all and will not produce a raised loaf by itself while others like hard winter wheat have a great deal and makes excellent raised bread. Whether gluten content is of importance to you will depend upon the end uses you intend for your grain.

Some of the common and relatively uncommon types of grains and their varieties are listed below.

AMARANTH: Amaranth is not a true cereal grain at all, but is a relative of the pigweeds and the ornamental flowers we call "cockscomb". It's grown not only for its seed, but for its leaves that can be cooked and eaten as greens. The seed is high in protein, particularly the amino acid lysine which is limited in the true cereal grains. It can be milled as-is, or toasted to provide more flavor. The flour lacks gluten, so it's not suited for raised breads, but can be made into any of a number of flat breads. Some varieties can be popped much like popcorn, or can be boiled and eaten as a cereal, used in soups, granolas, and the like. Toasted or untoasted, it blends well with other grain flours.

BARLEY: Barley is thought by some to be the first grain ever grown by man. It has short, stubby kernels with a hull that is difficult to remove. Excluding barley intended for malting or animal feed, most of this grain is consumed by humans in two forms. Most common is the white, highly processed "pearl barley" with much of its bran and germ milled off along with its hull. It is the least nutritious form of barley. The second offering is called "pot" or

"hulled barley" and it has been subjected to the same milling process as pearled, but with fewer trips through the polisher. Because of this, it retains more of the nutritious germ and bran. Unless you are prepared to try to get the hulls off I don't recommend buying unhulled barley. Although it can be milled into flour, its low gluten content will not make a good loaf of raised bread. It can be combined with other flours that do have sufficient gluten to make leavened bread or used in flat breads. Barley flour and flakes have a light nutty flavor that is enhanced by toasting. Whole barley is commonly used to add thickness to soups and stews.

Recently, a hull-less form has become available on the market through a few suppliers. This is whole grain barley with all of its bran and germ intact and should have the most nutrients of any form of this grain available. I have not yet been able to discover yet how suitable it is for long term storage.

BUCKWHEAT: Buckwheat is another of those seeds commonly considered to be a grain, but which is not a true cereal. It is a close relative to the docks and sorrels. The "grain" itself is a dark, three cornered seed resembling a tiny beechnut. It has a hard, fibrous hull requiring a special buckwheat huller to remove it. Here in the U.S., it is most often used in pancakes, biscuits and muffins. In Eastern Europe and Russia it is known in its toasted form as "kasha". In the Far East, it's often made into "soba" or noodles. It's also a good bee plant, producing a dark, strongly flavored honey. The flour is light or dark depending on how much of the hull has been removed before grinding. Dark flour is much more strongly flavored than lighter flour, but because of the high fiber and tannin content of its hull it is not necessarily more nutritious. Buckwheat is one of those foods with no middle ground in peoples opinions -- they either love it or they hate it. Like amaranth, it's high in lysine, an amino acid commonly lacking in the true cereal grains.

CORN: (maize) Corn is the most common grain crop in the U.S., but it is mostly consumed indirectly as animal feed or even industrial feedstock rather than directly as food. As one of the "Three Sisters" (corn, squash and beans) it was the staple grain of nearly all of the indigenous peoples of the American continents before the advent of European colonization. It comes in an amazing variety of forms with some being better suited for a particular purpose than others. The varieties intended to be eaten as fresh, green corn are very high in sugar content and do not dry or store well. The other varieties are the flint, dent, flour, and popcorns. All of them keep well when they have been properly dried. To a certain extent, they're all interchangeable for purposes of grinding into meal (sometimes known as polenta meal) or flour (very finely ground corn, not cornstarch), but some make better meal than flour and vice versa.

As a general rule of thumb, the flint varieties make better meal as they have a grittier texture than the other corns. If meal, hominy and hominy grits (commonly called just "grits") are what you are most interested in, use the flint type. If you intend to make corn masa for tortillas and tamales, then the flour type is what you want, but it is seldom found on the commercial market so the dent type is next best. Popcorn is what you need if you want to pop it for snacks and it can

also be ground into meal or flour. It seems to me it makes a very good meal, but it's a bit gritty for flour. It's also difficult to hull it with alkali treatment. Your mileage may vary. Yellow dent corn seems to be the most commonly available variety among storage food dealers and will work fine for almost any purpose but popping.

Popcorn is one form of a whole grain available to nearly everyone in the U.S. if they know where to look. It is so popular as a snack food, particularly in movie theaters and events like fairs and ball games, that even the smallest of towns will generally have at least one business selling it in twenty-five or fifty pound bags. Since it's meant to be eaten it's safe for food. To be at its most "poppable", this corn needs to have a moisture content between 13.5%-15.5% which makes it just a little too moist for ideal storage. A small amount of drying will need to be done before it's packed away. If wanted for popping later, it can always be re-hydrated by sprinkling a tablespoon of water per quart of kernels, shaking vigorously and allowing it to be absorbed for a day or two. If you still get too many "old maids" or unpopped kernels then repeat the process once more. Popcorn is harder than the other varieties of corn so if your mill is not of the heavy duty sort you may want to consider cracking the popcorn into coarse pieces first then grinding into finer textured meal.

Once you've decided between flint, dent or popcorn, (the flour types are difficult to find commercially) you now have to decide upon it's color: There are yellow, white, blue, & red dried varieties. The yellow and white types are the most common by far with the blues and reds mostly being relegated to curiosities, though blue corn has been gaining in popularity these last few years. It should be kept in mind that white corn does not have the carotene (converts into vitamin A) content of yellow corn. Since vitamin A is one of the major limiting vitamins in long term food storage, any possible source of it should be utilized. For this reason I suggest storing yellow rather than white corn. Additionally, much of the niacin content of corn is chemically bound up in a form not available for human nutrition unless it has been treated with an alkali. This is really of importance only if 85% or more of your daily calorie intake will come from corn, but grits, hominy or corn masa (for tortillas and tamales) are traditional uses for this grain and can go a long way toward increasing the number of recipes you can make with it. Give them a try, they're really quite good.

MILLET: Millet is an important staple grain in North China and India, but is little known as a food in the U.S, where we mostly use it as bird feed. The grain kernels are very small, round, and usually ivory colored or yellow, though some varieties are darker. The lack of gluten and a rather bland flavor may account for the anonymity of this grain but it has a more alkaline pH than other grains and makes it very easy to digest. It also has a higher iron content than any other grain but amaranth. It swells a great deal when cooked and supplies more servings per pound than any other grains. When cooked like rice it makes an excellent breakfast cereal. It has little gluten of its own, but mixes well with other flours.

OATS: Though the Scots and the Irish have made an entire cuisine from oats, it is still mostly thought of in the U.S. as a bland breakfast food. Seldom found as a whole grain, it's usually sold

processed in one form or another. Much like barley, oats are a difficult grain to separate from their hulls. Besides its longtime role as a breakfast food, oats make an excellent thickener of soups and stews and a filler in meat loafs and casseroles. Probably the second most common use for oats in America is in cookies and granolas. A little creative thought can really increase their culinary range.

Listed below in order of desirability for storage are the forms of oats found in this country. Rolled and cut oats retain both their bran and their germ.

Oat groats: These are whole oats with the hulls removed. They are not often found in this form, but can sometimes be had from natural food stores and some storage food dealers. Oats are not the easiest thing to get a consistent grind from so producing your own oat flour takes a bit of experience.

Steel cut oats: Also known as Irish, pinhead or porridge (but so are rolled) oats. These are oat groats which have been cut into chunks with steel blades. They're not rolled and look like coarse bits of grain. This form can be found in both natural food stores (sometimes much cheaper) and many supermarkets.

Rolled oats: These are also commonly called old fashioned, thick cut or porridge oats. To produce them, oat groats are steamed and then rolled to flatten. They can generally be found wherever oats are sold. They take slightly longer to cook than do the quick cooking oats, but they retain more flavor, texture and nutrition. This is what most people will call to mind when they think of oatmeal.

Quick cooking rolled oats: These are just steamed oat groats rolled thinner than the old fashioned kind above so that they will cook faster. They can usually be found right next to the thicker rolled oats.

Instant rolled oats: These are the "just add hot water" or microwave type of oat cereals and are not particularly suited for a storage program. They do, however, have uses in "bug out" and 72 hour food kits for short term crises.

Whole oats: This is with the hulls still on. They are sold in seed stores and sometimes straight from the farmer who grew them. Unless you have some means of getting the hulls off, I don't recommend buying oats in this form. If you do buy from a seed supplier, make certain that they have not been treated with any chemicals that are toxic to humans.

QUINOA: Quinoa is yet another of the grains that is not a true cereal. It's botanical name is Chenopodium quinoa (pronounced "keen-wah"), and is a relative of the common weed Lambsquarter. The individual kernels are about 1.5-2 mm in size and are shaped rather like small flattened spheres. When quinoa is cooked, the germ of the grain coils into a small "tail" that lends a pleasant crunch. This exotic grain should be thoroughly washed before cooking in order to prevent it from tasting bitter. There are several varieties of quinoa that have color ranging from near white to a dark brown. The larger white varieties are considered superior and are the most common.

RICE: Rice is the most commonly consumed food grain in the world. The U.S. is the leading exporter of it, though we actually only produce about 1% of the global supply. The majority of the world's rice is eaten within five miles of where it was grown.

Much like wheat and corn, rice comes in a number of varieties, each with different characteristics. They are typically divided into classes by the length of their kernel grains; short, medium and long.

Short grain rice: The short grain variety is a little softer and bit moister when it cooks and tends to stick together more than the longer rices. It has a sweeter, somewhat stronger flavor than long grain rice.

Medium grain rice: The medium grain variety is not very common in the States. It has flavor like the short variety, but with a texture more like long.

Long grain rice: The long grain variety cooks up into a drier, flakier dish than the shorter types and the flavor tends to be blander. It is the most commonly found size of rice on American grocery shelves.

Each of the above may be processed into brown, white, parboiled or converted and instant rice. Below is a short discussion of the differences between the various types.

Brown rice: This is whole grain rice with only the hull removed. It retains all of the nutrition and has a pleasant nutty flavor. From a nutritional standpoint it is by far the best, but it has one flaw: The essential oil in the germ is very susceptible to oxidation and soon goes rancid. As a result, brown rice has a shelf life of only about six months from the date of purchase unless given special packaging or storage. Freezing or refrigeration will greatly extend this. It's possible to purchase brown rice from long term food suppliers already specially packaged in air tight containers with an inert nitrogen atmosphere or you can do it yourself. In this kind of packaging, (if properly done), the storage life can be extended for several years.

Converted rice: Converted rice starts as whole rice still in the hull which undergoes a process of soaking and steaming until it is partially cooked. It is dried, hulled and then polished to remove the bran and germ. The steaming process drives some of the vitamins and minerals from the outer layers into the white inner layers. This makes it more nutritious than polished white rice, but also makes it more expensive. Its storage life is the same as regular white rice.

White rice: This is raw rice that has had its outer layers milled off, taking with it about 10% of its protein, 85% of its fat and 70% of its mineral content. Because so much of the nutrition is lost, white rice sold in the U.S. has to be "enriched" with vitamins to partially replace what was removed.

Instant rice: The type of rice is fully cooked and then dehydrated needing nothing more than the addition of water to reconstitute it. In a pinch, it's not even necessary to use hot water. It's not

particularly suitable for inclusion in storage programs, but it does have a place in "seventy-two hour" and other short-term emergency kits. The white variety is by far the most common, but in the last few years instant brown rice has made an appearance on the market.

RYE: Rye is well known as a bread grain in the U.S. It has dark brown kernels longer and thinner than wheat, but less gluten. Bread made from this grain tends to be somewhat dense unless gluten is added (often in the form of a lot of wheat flour) with color that ranges from pale to dark brown. German pumpernickel, made with unrefined rye flour and molasses, is the darkest, densest form.

SORGHUM: Sorghum is probably more widely known here in the States for the syrup made from it. Also known as "milo", it is one of the principle cereal grains grown of Africa. Its seeds are somewhat round, a little smaller than peppercorns, of an overall brown color with a bit of red and yellow mixed in. The varieties called "yellow endosperm sorghum" are considered to have a better taste. It is a major feed grain in the Southwestern U.S. and is where the vast majority of the national production goes. Like most of the other grains, sorghum is low in gluten, but the seeds can be milled into flour and mixed with higher gluten flours or made into flat breads, pancakes or cookies. In the Far East, it is cooked and eaten like rice, while in Africa it is ground into meal for porridge. It's also fermented for alcoholic beverages.

TRITICALE: Triticale is not a creation sprung from the smooth brows of *Star Trek* script writers. It is, in fact, a cross or hybrid between wheat and rye. This youngest of grains combines the productivity of wheat with the ruggedness of rye and has a high nutrition value. The kernels are gray-brown, oval shaped larger-than-wheat and plumper than rye. It can be used in much the same way as either of its two parents. It will make a raised bread like wheat does, but the gluten is a bit weak so wheat flour is frequently added to strengthen it. Because of the delicate nature of its gluten, excessive kneading must be avoided. Although it is the youngest of the grains, it's been around for decades, but has curiously never achieved much popularity. Whether this is for reasons of agricultural production or public acceptance I don't know.

WHEAT: Wheat comes in a number of different varieties. Each variety is more suitable for some purposes based on its characteristics. The most common classifications for its varieties are spring or winter, hard or soft, red or white.

The hard wheats have kernels that tend to be small, very hard and with high gluten contents. Low gluten wheat does not produce as fine a loaf as high gluten wheat, though it can still be used for yeast breads if necessary. As a general rule, hard varieties have more protein than soft varieties.

The soft wheats have kernels tending to be larger, plumper and softer in texture than hard wheats. Their gluten content is less and are used in biscuits, pastries, quick breads, pastas, and breakfast

cereals where a higher gluten content would contribute an undesirable tougher texture.

Winter wheats are planted in the fall, over winter in the field and are harvested the next summer. Spring wheats are planted in the early spring and are harvested in the fall. Red wheats comprise most of the hard varieties while white wheats comprise most of the soft. Recently, hard white wheats have been developed that are very suitable for raised bread making. Some feel the hard white varieties make a better tasting whole wheat bread than the hard red.

The hard red varieties, either spring or winter, are the most commonly stored because of their high protein and should have no less than 12%. The hard white spring wheats are still relatively new and are not yet as widespread. They have the same excellent storage characteristics as the hard red wheats.

## A.2 LEGUME VARIETIES

Unless you are willing to spend a great deal of money on preserved meats, a food storage program not including a large quantity of legumes is simply incomplete. There are few non- animal foods that contain the amount of protein to be found in dried beans, peas, and lentils. The varieties commonly available in this country have protein contents ranging from 20%-35%. As with most non-animal proteins, they are not complete in themselves for purposes of human nutrition, but become so when they are combined with the incomplete proteins found in grains. It is for this reason that grains and legumes are so often mentioned together. In cultures all over the world, it is common to find the two served together at a meal, making a complete protein, even when those doing the serving have no scientific understanding of nutrition at all.

The legume family, of which all beans, peas, lentils, and peanuts are a part, is one of the largest in the plant kingdom. Because of this and the many thousands of years of development and cultivation that man has given them, the variety of edible legumes available to us is huge. Both the appearance and the names of these varieties are colorful and varied. They range from "adzuki beans", a type of soybean from the Orient, to "zipper peas", a commonly found field-pea here in the Southern U.S. Their color can range from a clean white, to deep red, dull green to flat black with thousands of mixtures and patterns of colors.

In spite of this incredible variety of names and colors, legumes are largely interchangeable in cooking usage, although some dishes just wouldn't be the same if a different type were used. Below is a partial list of some of the more commonly eaten bean varieties here in the U.S.

BLACK BEAN: Also known as "turtle beans", these small, dark brownish-black, oval-shaped beans are well known in Cuban black bean soup. They are very commonly used in Central and South America and in China. They tend to bleed very darkly when cooked so they are not well suited to being combined with other beans, lest they give the entire pot a muddy appearance.

BLACK-EYED PEA: Although there is tremendous variation among the many varieties of field-peas eaten throughout the Southern United States, it is black-eyed peas that are the most commonly known nationwide. The coloring of field-peas is as varied as the rest of the legume family, with black-eyed peas being small, oval-shaped with an overall creamy color and, of course, their distinctive black-eye. Dried field-peas cook very quickly and combine very tastily with either rice or cornbread.

CHICKPEA: Also known as the "garbanzo bean" or "cecci pea" (or bean), it tends to be a creamy or tan color, rather lumpily roundish and larger than dried garden peas. Many have eaten chickpeas, even if they've never seen a whole one. They are the prime ingredient in hummus and falafel and are one of the oldest cultivated legume species known, going back as far as 5400 B.C. in the Near East.

KIDNEY BEANS: Just like the rest of the family, kidney beans can be found in wide variety. They come in both a light and dark red color in their distinctive kidney shape. Probably best known here in the U.S. for their use in chili, they figure prominently in Mexican, Brazilian and Chinese cuisine.

LENTILS: Lentils are an odd lot. They don't fit in with either the beans or the peas and occupy a place by themselves. Their shape is different from the other legumes being roundish little discs with colors ranging from muddy brown, to green to a rather bright orangish-red. They cook very quickly compared to the larger beans and have a distinctive flavor. They are much used in Far Eastern cuisine from Indian to Chinese.

LIMA BEANS: In the Southern U.S., they are also commonly called "butter beans". They are one of the most common legumes found in this country in all manner of preservation from the young small beans to the large fully mature type. Their flavor is pleasant, but a little bland. Their shape is rather flat and broad with colors ranging from pale green to speckled cream and purple.

PEANUTS: The peanut, commonly known outside the U.S. as the "groundnut", is not actually a nut at all, but a legume. They are another odd species not much like the more familiar beans and peas. Whatever their classification peanuts are certainly not unfamiliar to U.S. eaters. Peanuts have a high protein percentage and even more fat. They are one of the two legume species commonly grown for oilseed in this country, and are also used for peanut butter, and boiled or roasted peanuts. Many Central and South American, African and Chinese dishes incorporate peanuts so they are useful for much more than just a snack food or cooking oil.

PINTO BEANS: Anyone who has eaten Tex-Mex food has probably had the pinto bean. It is one of the most commonly eaten beans in the U.S., particularly in the Southwestern portion of the

country.  Stereotypically bean shaped, it has a dappled pattern of tans and browns on its shell.  Pintos have a flavor that blends well with many foods.  When ground together with white or navy beans they make my favorite home-made version of falafel.

SOYBEANS: An entire university could be founded on the culinary and industrial uses of the soybean.  It is by far the legume with the highest protein content in commercial production as well as being the other legume oilseed alongside the peanut.  The beans themselves are small, and round with a multitude of different shades. Because of their high oil content, they are more sensitive to oxygen exposure than other legumes and precautions should be taken accordingly if they are to be kept for more than a year in storage.  Although the U.S. grows a very large percentage of the global supply, we consume virtually none of them directly.  Most of them go into cattle feed, are used by industry or exported.  What does get eaten directly has usually been processed in some fashion.  Soybean products range from tofu, to tempeh, to textured vegetable protein (TVP) and hundreds of other uses. They don't lend themselves well to just being boiled until done and eaten the way other beans and peas do.  For this reason, if you plan on keeping some as a part of your storage program (and you should) you would be well served to begin to learn how to process and prepare them now when you're not under pressure to produce.  That way you can throw out your mistakes and order pizza, rather than having to choke them down, regardless.

## A.3  TYPES OF AVAILABILITY OF GRAINS AND LEGUMES

Grains and legumes of all types may be purchased in a number of different fashions depending largely on where you live and what time of year it is.  The following will cover the various steps in the processing chain where they might be found starting with the forms most immediately suitable for storage and progressing all the way back to the farmer.

Each type of availability has its good and bad points.  As you might expect, the more processing the product receives, the higher its price is likely to be.  The further back along the processing chain you go the cheaper the product should become in terms of purchase price.  It will, however, cost you more in time and effort to get it into a condition ready to put it into storage.

The easiest and simplest way to incorporate grains and legumes into your storage program is to purchase your items "pre-cleaned and pre-packaged".  This is grain or legumes that have been harvested, cleaned and put up in bags or other containers-possibly even going so far as to already be packaged for long-term storage.  If you don't live in the area where they are grown, it is probably your only option.

If you want to purchase in bulk then you may be able to find "pre-cleaned" which means that it has been passed through fans, screens or sieves to remove chaff, smut balls, insect parts, mouse droppings and other debris.  It probably won't be in any form of packaging and you may have to provide your own container.  There may be minimum purchase amounts as well.  If the moisture content is in the right range then nothing will need to be done other than to put it up in your own storage

packaging.  Be certain to make sure it is intended for human food use, otherwise read the cautionary text below.

Should you happen to live in the area where the type of grain or legume that you are interested in purchasing is grown you may be able to purchase direct from the producer or distributor.

If you are interested in doing this, it may be possible to find your product "field-run" which means that it's been harvested and sold shortly thereafter.  It will not have been given any cleaning or processing and is likely to be rather dirty depending upon the conditions under which it was grown and harvested.

A second form called "field-run from storage" is product that has been harvested and then put into storage for a time.  It will have all of the dirt and detritus of field run grain and whatever it may have picked up from the silo as well.

IMPORTANT NOTE:  If you have purchased your grains and legumes from a foods dealer then you needn't worry about hidden mold infections, fungicides or insecticides that are unsafe for human consumption.  In the U.S., the products will have been checked several times by Federal and State agriculture departments and probably by the major foods dealers as well, to ensure its quality.

This is not necessarily the case when you purchase your grains or legumes directly from the farmer or elevator operator as field-run or field-run from storage grain.  Nor is it necessarily the case if you've made the decision to utilize grains marketed as animal feed.  Inspection procedures vary from nation to nation, so if you buy outside of the U.S. inquire of your supplier.

If you are buying your grains and legumes from some place other than a foods dealer, you need to know the history of what you are buying.  There is the remote possibility that field-run from storage or any grade of grain not specifically sold for human consumption may have had fumigants, fungicides or insecticides not certified as safe for human foods added while it was in the bin.  It is important to know what it has been treated with before you buy it.

Straight field-run grain, other than being dirty, is not likely to have had anything added to it that would make it undesirable for human consumption.  There is, however, the also remote possibility it may have been infected with fungi that would make it unsafe for eating.

One of these fungal infections of grain is called "ergot".  This fungal disease affects the flowering parts of some members of the grass family, mostly confined to rye.  Consuming the fungus causes a nervous disorder known as St. Anthony's Fire.  When eaten in large quantities the ergot alkaloids may cause constriction of the blood vessels, particularly in the extremities.  The effects of ergot poisoning are cumulative and lead to numbness of the limbs and other, frequently serious, symptoms.

The fungus bodies are hard, spur like, purple-black structures that replace the kernel in the grain head.  The ergot bodies can vary in size from the length of the kernel to as much as several times as long.  They don't crush as easily as smut bodies of other funguses.  When they are

cracked open, the inner broken faces can be off-white, yellow, or tan. The infected grain looks very different from ordinary, healthy rye grains and can be spotted easily. Ergot only rarely affects other grains and will generally afflict rye only when the growing conditions were damp. If you purchase field run rye, you should closely examine it first for the presence of ergot bodies. If you find more than a very few, pass up that grain and look elsewhere.

Ergot is typically not a common problem in the U.S and is easily spotted when it does occur. Other grain fungi, however, are much harder to spot and also have serious consequences should they be consumed. The various species of "Aspergillus" and "Fusarium" molds can be a problem almost anywhere and should be kept in mind. *Please see Section III.B Molds In Grains and Legumes for more information concerning this.*

Sometimes grain in the form of animal feed or seed grain/legumes is available. Keep in mind animal feeds may have a higher contaminant level than what is permissible for human consumption. Under certain circumstances, the USDA allows the sale of grain or legumes for animal feed that could not be sold for direct human food use. It may even be mixed varieties of one grain and not all one type. Seed grains, in particular, must be investigated carefully to find out what they may have been treated with. It is quite common for seed to have had fungicides applied to them, and possibly other chemicals as well. Once treated, they are no longer safe for human or animal consumption.

If you do purchase field-run grain of any sort, examine it closely for contamination and moldy grain. Ask the farmer or distributor whether it has been tested for mold or "mycotoxin" (fungal toxin) content. This is especially the case if you are buying field-run CORN, RYE, SOYBEANS or RICE. When you purchase direct from the field, you may be getting it before it has been checked. Be certain of what it is that you are getting and ask questions if you choose to go this route. Know who you are dealing with. Unless you just can't find any other source, I don't recommend using animal feed or seed grains for human food.

*Please see section III.B.3 " Molds In Grains and Legumes" for further information.*

### A.3.1 MOISTURE CONTENT

The moisture content of the grain or legume you want to put by has a major impact on how long you will be able to keep it in storage and still remain nutritious and edible. Some of the available literature states that grain with a moisture content as high as 13% can be safely put up, but there is a risk to keeping it at that moisture level that should be understood.

The outside of every kernel of grain and bean you buy or grow hosts thousands of fungi spores and bacteria. This is all perfectly natural and is not a reason for alarm. The problem lies in that at moisture levels between 13.5% to 15% some fungal species are able to grow and reproduce. Aerobic bacteria (needing free oxygen to survive) require moisture in the 20% range. If you have grain with a moisture content as high as 13% you are perilously close to having enough moisture to enable mold growth which could lead to the spoilage and loss of your product.

For this reason, I suggest you keep all grains and legumes to a moisture content of no more than 10%. An exception to this is raw peanuts which are particularly susceptible to an Aspergillus mold growth that produces aflatoxin (a type of mycotoxin) and should be stored with an 8% moisture content or less.

If you do not have a clue as to what the moisture level of your grain is here are several methods to determine it. The first method requires a great deal more oven time, but is the simplest and has less room for error to creep in. The second method is much quicker, but greater care must be taken to prevent mistakes.

Highly precise moisture content measurements generally require equipment and facilities beyond the scope of what can be had by the average person. It is still possible though to make some determinations that will be of real use for our purposes.

You'll need some way to measure weight with a fair degree of accuracy. The better the scale you use, the more reliability you'll have in your determinations. Provided that it will weigh accurately to the half-ounce or less, any scale that can be calibrated with a known check weight will do. Even postal scales can be made to serve if they are carefully calibrated against a known weight. Many individuals interested in starting storage programs may have grain weight scales used in ammunition reloading that might serve well.

Also necessary is a thermometer capable of withstanding and accurately measuring oven temperatures. As many bakers can tell you, home oven thermostats are often notoriously inaccurate so it is better to rely on a decent thermometer. Most kitchen supply stores can supply one that is oven safe and will accurately measure to the degree Fahrenheit or Celsius.

Proper technique calls for preheating the oven for a half-hour or more before starting the dehydrating process so that it will be of a uniform heat throughout. The sample pan should be placed on the middle rack as close to the vertical and horizontal center of the oven as possible. The bulb or dial of the thermometer should be placed next to the pan.

METHOD ONE.

This method is for measuring moisture content in whole grains and legumes. Grain flours or meals, milk powders and any other finely textured foods should use method two detailed below.

To be done prior to measuring -- choose a shallow heat resistant container that has a close fitting lid. Clean it thoroughly and dry it completely in your oven for 10-15 minutes. Allow it to cool and then weigh it carefully. This will give you the tare weight or what your container weighs empty.

Depending on how your scale is calibrated you can use a smaller sample size than what is indicated below. Using the twenty-ounce sample mentioned in the following text will allow for fairly accurate readings with the average postal scale. A scale that will measure to the gram could use as small a sample as 20 grams. A powder scale could use even

less, but the smaller your sample size becomes the more finicky care you must take not to allow error to creep in. Keep your sample size large enough to easily work with.

Allowing for the weight of the sample pan, measure out a weighed twenty-ounce representative sample of the grain or legumes in question. Ideally, you should mix the entire lot thoroughly immediately before removing the sample, but if this is not possible then take it from the middle center of the container. It is important that you use care in this measurement since it will affect all following determinations.

Put the sample in the container making sure it is not more than an inch deep. Place it in the oven with the lid off and allow to heat. Below is a table giving the oven temperatures and times per grain or legume type:

Time and Temperature Settings for Determining Moisture Contents of Whole Seeds.

| Seed | Oven Temperature Deg. F | C | Oven Time Hours |
|---|---|---|---|
| Barley | 266 | 130 | 20 |
| Beans | 217 | 103 | 72 |
| Corn | 217 | 103 | 72 |
| Oats | 266 | 130 | 22 |
| Rye | 266 | 130 | 16 |
| Sorghum, millet | 266 | 130 | 18 |
| Soybeans, peanuts | 217 | 103 | 72 |
| Wheat, rice | 266 | 130 | 19 |

When the dehydration period is over place the close fitting lid on the sample pan and allow to cool in the oven with the door closed. Remove the pan and carefully weigh it.

A one ounce loss in weight indicates your grain has a roughly five percent moisture content, 2 ounces indicates that it has a 10% moisture content, etc., etc. You might even be able to cut it as fine as a half oz loss, but I wouldn't try to take it further than that.

Obviously, this is only a rough measure, but it works and can be done with postal or dietetic scales that are available virtually everywhere. As I mentioned above, if you have a scale with a finer calibration it is possible to use a smaller sample size and achieve the same result.

If anyone has a better way of measuring moisture levels which can be done without a lab or special equipment I'd surely like to hear it.

METHOD TWO

This method is much faster to use than the first, but greater care must be taken to prevent error. It can be used to determine moisture

contents of whole grains and legumes, flours, meals and various food powders.

The same equipment as was used in Method One will be required here as well as a low-RPM grain mill or some other device that can reduce a quantity of the grain to a meal consistency with only minimal heating of the sample. If the food to be tested is already at a meal consistency or finer then it can be used as-is.

Grind a quantity of product you want to measure the moisture content of. Take care to grind the sample slowly enough to keep friction heat build up to a minimum or else moisture will be lost due to heat evaporation before it can be weighed.

Immediately upon finishing the grinding, weigh out your sample so as to minimize unmeasured moisture loss.

Place the sample in the oven and dehydrate in the manner used in Method One for a period of two hours at a temperature setting of 275 deg. F (135 deg. C). When the heating period is finished cover with the tight-fitting lid and allow to cool in the oven. Remove and weigh carefully. Moisture determination is the same as above.

### A.3.2 CLEANING IT YOURSELF

If you've chosen to purchase field-run grain or if the pre-cleaned product you've bought isn't clean enough, you can do it yourself.

The fastest and easiest method is "fanning", a form of winnowing. This is done by pouring the grain slowly through the air stream of a fan or blower into a clean, deep container such as a cardboard box or trash can. The wind blowing through the falling grain will blow out most of the broken kernels, chaff, smut balls, mouse droppings, etc. If you're losing too much good grain, try turning the fan down or moving it further back from the container. The deep container will cut down on the amount of kernels that bounce out. Repeat fanning as necessary until the grain is clean enough to suit or you've blown all of the lighter contaminants out.

If the fanning didn't get the grain clean enough it can be further cleaned by running it through a screen or sieve. This should be made with holes just big enough to pass an average sized grain of what it is you're cleaning. Obviously, the size of the holes will necessarily vary depending upon the kernel size of the grain.

Should the kernels still not be clean enough to suit then you'll just have to resort to hand picking out the offending particles. I'd strongly suggest doing this just prior to grinding where it can be done in small batches rather than trying to do your entire storage all at once. It's much easier to do a few pounds at a time than fifty or a hundred.

If you have it in mind to wash the grain, this should not be done prior to storage, but, rather, just before use. After it's been rinsed, it should be dried immediately in the oven by placing it no deeper than 1/2 inch and heated at 150 deg. F for an hour. It should be stirred

occasionally to improve drying.

### A.4 STORING GRAINS AND LEGUMES

Now that you have properly prepared your grains and legumes for storage, they are ready to be packaged.

*For methods and procedures of packaging please see section IV.*

IV. Specific Equipment Questions
- A. Storage Containers
- B. CO2 and Nitrogen
- C. Oxygen Absorbers
- D. Desiccants
- E. Diatomaceous Earth

## B. DRY MILKS

Got milk? In the refrigerator, right? Milk is a great source of essential amino acids and vital calcium, but in its fresh liquid form it is a highly perishable commodity. Fortunately, milk can be found in several forms that lend themselves to food storage. The various types of dry milks are the best suited to the task.

### B.1 TYPES OF DRY MILKS

NONFAT: This is pasteurized skim milk reduced to a powdered concentrate. It can be found in two forms, regular and instant. They are both made from milk in a spray-drying process, but the instant variety has been given further processing to make it more easily soluble in water than regular dry milk. Both types have the same nutrient composition. The regular variety is more compact and requires less storage space than the instantized variety, but it is more difficult to reconstitute. The most easily found variety is the instant, available in nearly any grocery store. The regular variety has to be sought out from baking and restaurant suppliers and storage food dealers.

It takes 3.2 oz or about 3 tablespoons of instant nonfat dry milk added to 8 oz of water to make 1 cup of milk you can drink or cook with just like fresh milk, albeit with a considerable flavor difference. Combining the dry milk with water at least several hours before you plan to use it gives it time to dissolve fully and to develop a fresher flavor. Shaking the fluid milk vigorously will incorporate air and will also help to improve flavor. Add the powder to baked goods, gravies, smoothies, hot cereals, casseroles and meat loaf as a nutrition booster. It can also be used to make yogurt, cheese and most any cultured dairy product that does not require a high fat content.

FLAVORED NONFAT: This may be found packaged in a variety of forms from a low calorie diet drink (artificially sweetened) to the other end of the scale, as cocoa mix or malted milk. The key ingredient is the dry milk so buy and store these products accordingly.

WHOLE MILK: This is whole dry milk with all of its fat content and therefore has a shorter shelf life than nonfat. Other than that, it can be used in exactly the same way. Dry whole milk is difficult to find, but can sometimes be found where camping and outback supplies are sold.

BUTTERMILK: Dry buttermilk is for use in recipes calling for buttermilk. Since it has a slightly higher fat content than nonfat dry milk, it generally does not keep as long.

### B.1.1 BUYING DRY MILK PRODUCTS

(a)- Be sure the dry milk you are buying has been fortified with vitamins A and D. All of the nonfat dry milks I've seen come fortified with these two vitamins. The dry buttermilk does not come this way, at least the SACO brand does not. I don't know if the flavored mixes and the dry whole milk do or not.

(b)- There should be no artificial colors or flavors. I believe it is illegal to add preservatives to any dry milk sold in the U.S. so a claim of "no preservatives" on the label is of no consequence. Other nations may be different, however.

(c)- "Extra Grade" on the label indicates the manufacturer has held to higher processing and quality standards and the milk is somewhat lower in fat, moisture and bacterial content, is more soluble, and has fewer scorched particles.

There are still some manufacturers of dry milk that sell ordinary Grade A product, but they are becoming fewer. Every brand of instant powdered milk in my local grocery store is the Extra Grade, even the generic store brand. This, too, may vary outside of the States.

(d)- Try to buy your dried milk in containers of a size that makes sense for the level of consumption in the household. Once it is opened, powdered milk has a short shelf life before undesirable changes in flavor and nutrient content occurs. If you buy large packages and do not use much at one time, consider breaking it down and repackaging into smaller containers at the time of purchase.

(e)- As with any storage food you buy, try to deal only with reputable dealers. It is particularly important to do this with dry milk because of its short shelf life and sensitivity to storage conditions. Check expiration dates, then date and rotate packages.

### B.2 STORING OF DRY MILKS

Dry milk products are probably the most sensitive to environmental conditions storage foods there are, particularly to temperature and moisture content. Their vitamins A and D are also photosensitive and will break down rapidly if exposed to light.

The area where your dry milk is stored should be kept as cool as possible. If it is possible to do so, air-conditioning or even refrigeration can greatly extend the nutrient shelf life.

If the storage container is transparent or translucent then it should be put into a second container opaque to light or stored in a dark room.

Dry milk will absorb moisture and odors from the air so storage containers should be impervious to both air and moisture. The drier it can be kept, the better it will keep. The use of desiccants is an excellent idea. Oxygen also speeds decomposition. Powdered milk canned with nitrogen or carbon dioxide to replace air (which contains oxygen) will keep longer than powdered milk exposed to air. Vacuum canning also decreases the available oxygen.

If the dry milk purchased was not packaged for long term storage then it should be repackaged right away.

I purchase the instant variety at my local grocery and repack it when I get it home. I've seen a number of methods used for this and any of them should work.

The method I now use is to pour the powder into clean, dry half-gallon canning jars. Once the jars are filled I add a small desiccant pack and seal. They are dated and stored in the ubiquitous cool, dark place. They must be guarded against breakage, but they offer the advantage of not holding odors, thus allowing for reuse after suitable cleaning. Since they are as transparent the contents must be protected against light. Vacuum sealing and then storing in a dark place may be the best method. Larger jars of 1 gallon size could be used and then re-vacuum sealed after each use. An O2 absorber would take care of any remaining oxygen and would, itself, last longer when used in conjunction with the vacuum sealer. Being glass, the jar can be reused as well as the lid and ring if they're properly cleaned.

Clean, sound plastic one and two liter soda bottles can also be used, but probably should be used just once since the plastic is somewhat permeable and will hold odors.

If you have access to a can sealer, #10 cans make wonderful storage containers for dry milk, particularly if used in conjunction with O2 absorbers.

Another method I've seen used is to remove the paper envelopes of milk powder from the cardboard box they come from the grocery store in and to put them in dated plastic bags. These bags are not sealed. The unsealed bags are then placed in a larger, air tight, opaque container. I've heard of plastic buckets, fifty cal and 20 mm ammo cans being used for this purpose. A healthy quantity of desiccant was also placed in the container. This would be another area where O2 absorption packets should serve well. It's important to remember the containers should be clean and odor-free.

*Please see Section IV Specific Equipment Questions for information concerning the proper use of containers, desiccants, compressed gasses, dry ice and oxygen absorbers.*

### B.2.1 SHELF LIFE OF DRY MILKS

From: SacoFoods@aol.com (Amy Thompson)
To: Dunross@dkeep.com (Alan Hagan)
Subj: SACO Mix'nDrink Instant Pure Skim Milk
Date: May 9, 1996

Dear Mr. Hagan:

Thank you for your e-mail today and for your interest in SACO Mix'nDrink Pure Skim Milk.

Our Mix'n Drink will keep its nutrition value for up to about two years if kept cool and dry, and the only vitamins that actually decrease over time are the vitamins A and D. These are not shelf-stable vitamins and are sensitive to heat and light. A good rule of thumb to follow is that the vitamins A and D will dissipate at a rate of about 20% every year if stored properly. The less heat and moisture the milk is exposed to, the better the vitamins will keep. A freezer could extend the shelf life, as long as the powder does not get moisture in it. If you had to put a time limit on the Mix'nDrink, for rotation purposes, I would date it at two years after the date of purchase.

After opening a package of dry milk, transfer the powder to a tightly covered glass or metal container (dry milk can pick up odors from plastic containers) and keep it in the refrigerator. Unsealed nonfat dry milk keeps for a few months; dry whole milk for a few weeks.

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From: SacoFoods@aol.com (Amy Thompson)
To: Dunross@dkeep.com (Alan Hagan)
Subj: SACO Mix'nDrink Instant Pure Skim Milk
Date: May 21, 1996

Dear Mr. Hagan:

Since vitamins A and D are heat and light sensitive, I would say that your 1 1/2 year shelf life is very reasonable. If you are trying to determine when the nutritional value has been affected more than 40%, as you previously indicated, you should be pretty safe with that time element, as long as it is not exposed to extreme heat.

[Eds note: We were discussing the higher average temperatures found in Florida and other hot climates and the effect that it would have on their dry milk's nutrient content]

## C. CANNED GOODS

### C.1 CANNED MILK TYPES

Preserved liquid milk comes in a number of forms, none of which are very similar to each other. The most common forms of these packaged milks are as follows:

CANNED MILKS: These are commonly called UHT milks (Ultra High Temperature) for the packaging technique used to put them up. They come in the same varieties as fresh liquid milks: Whole, 2%, 1% and skim. I've even found whipping cream in UHT packaging (Grand

Chef - Parmalat), though this may be offered only in the commercial and restaurant trade. In the U.S. they have vitamin D added. The lesser fat content milks do not keep as long as whole milk and their use by dates are correspondingly shorter term. This milk is packaged in aseptic containers, either cans or laminated paper cartons. It has the same composition as fresh milk of the same type, and can be stored at room temperature because of the special pasteurizing process used. The milk has a boiled flavor, but much less than evaporated milk. The dates are usually for approximately six months. The milk is still usable past its date, but the flavor soon begins to go stale and the cream separates. I am told by a friend who lived in Germany not long after this kind of canned milk began to come on the market there that they were dated for a year.

With a six-month shelf life this type of canned milk naturally requires a much faster rotation cycle than other types. The only brand name for this milk I've seen is Parmalat. Recently, I have discovered that it makes excellent yogurt, losing the boiled tasted

EVAPORATED: This is made from fresh, unpasteurized whole milk. A vacuum-heating process removes 60% of the water; the concentrate is heated, homogenized, and in the States vitamin D is added. It is then canned and heated again to sterilize the contents. It may also have other nutrients and chemical stabilizers added. A mixture of one part water and one part evaporated milk will have about the same nutritional value of an equal amount of fresh milk. There is generally no date or use by code on evaporated milk

Health and nutrition food stores often carry canned, evaporated goat's milk, in a similar concentration.

SWEETENED CONDENSED: This milk goes through much less processing than evaporated milk. It starts with pasteurized milk combined with a sugar solution. The water is then extracted until the mixture is less than half its original weight. It is not heated because the high sugar content prevents spoilage. It's very high in calories, too: 8 oz has 980 calories.

Although it is often hard to find, the label has a stamped date code which indicates the date by which it should be consumed. Sweetened, condensed milk may thicken and darken as it ages, but it is still edible.

### C.1.1 SHELF LIFE OF CANNED MILKS

Unopened cans of evaporated milk can be stored on a cool, dry shelf for up to six months. Canned milk (UHT) should be stored till the stamped date code on the package (3 - 6 months). Check the date on sweetened, condensed milk for maximum storage.

## C.2 CORROSION PREVENTION OF CANNED GOODS

Some areas have difficulty storing metal canned goods for long periods of time. This is usually caused by very high humidity or

exposure to salt in a marine environment. If this is a problem, it is possible to extend the life of metal cans by coating their outsides. I've seen this used on boats here in Florida, especially when loading for a long trip. There are at least four methods that can be used to do this:

PARAFFIN METHOD: Using a double boiler, paraffin is melted and brushed on the clean, unrusted cans. Be certain to get a good coat on all seams, particularly the joints. If the can is small enough, it can be dipped directly into the wax. Care must be taken to not cause the labels to separate from the cans. Do not leave in long enough for the can to get warm.

PASTE WAX METHOD: Combine 2-3 oz. of paste or jelly wax with a quart of mineral spirits. Warm the mixture CAREFULLY in its container by immersing it in a larger container of hot water. DO NOT HEAT OVER AN OPEN FLAME! Stir the wax/spirits thoroughly until it is well mixed and dissolved. Paint the cans with a brush in the same manner as above. Place the cans on a wire rack until dry.

SPRAY SILICONE: A light coating of ordinary spray silicone may be used to deter rust. Spray lightly, allow to dry, wipe gently with a clean cloth to remove excess silicone.

CLEAR COATING: A clear type of spray or brush on coating such as Rustoleum may be applied. This is best suited for larger resealable cans, but will keep them protected from corrosion for years.

## D. SUGAR, HONEY AND OTHER SWEETENERS

There are a wide number of sugars to be found for purposes of sweetening foods. Fructose is the primary sugar in fruit and honey; maltose is one of the sugars in malted grains; pimentose are found in olives and sucrose is what we know as granulated or table sugar. Sucrose is a highly refined product made primarily from sugar cane though sugar beets still contribute a fair amount of the world supply. Modern table sugar is now so highly refined as to be virtually 100% pure and nearly indestructible if protected from moisture. Powdered sugar and brown sugar are simple variations on granulated sugar and share its long life.

Liquid sweeteners do not have quite the longevity of dry sugars. Honey, cane syrup, molasses, corn syrup and maple syrup may crystallize or mold during long storage. These syrups are chemically not as simple as table sugar and therefore lose flavor and otherwise break down over time.

### D.1 TYPES OF GRANULATED SUGARS

Buying granulated sugar and its close cousins is really a very simple matter. Buy a brand you know you can trust and be certain the package is clean, dry and has no insect infestation. There's very little that can go wrong with it.

GRANULATED: Granulated sugar does not spoil, but if it gets damp it will likely cake up or get lumpy. If it does, it

can simply be pulverized again until it regains its granulated texture. Granulated sugar can be found in varying textures, coarser or finer. "Castor/caster sugar" is a finer granulation than what is commonly sold as table sugar in the U.S. and is more closely equivalent to our super fine or berry sugar.

POWDERED, CONFECTIONERS, ICING: All names refer to the same kind of sugar, that is white granulated sugar very finely ground. For commercial use there is a range of textures from coarse to ultra-fine. For home consumption, what is generally found is either Very Fine (6X) or Ultra-Fine (10X), but this can vary from nation to nation. Not all manufacturers will indicate the grind on the package though. Sugar refiners usually add a small amount of corn-starch to prevent caking.

Powdered sugar is as inert as granulated sugar, but it is even more hygroscopic and will absorb any moisture present. If it absorbs more than a little it may cake up and get hard. It's difficult to reclaim hardened powdered sugar, but it can still be used like granulated sugar.

BROWN, LIGHT & DARK: In the United States brown sugar is basically just refined white sugar that has had a bit of molasses or sugar syrup and caramel coloring added to it. Dark brown sugar has more molasses which gives it a stronger flavor, a darker color and makes it damp. Light brown sugar has less molasses which gives it a milder flavor, a blonder color and is slightly dryer than the dark variety. For storage purposes you may want to just stock the dark variety. Light brown sugar can be made by combining one fourth to one third white sugar to the remainder dark brown sugar and blend thoroughly.

Both varieties need to be protected from drying out, or they will become very hard and difficult to deal with. Nor do you want to allow them to become damper than what they already are.

There are granulated and liquid brown sugars available, but they don't have the same cooking qualities as ordinary brown sugars. They also don't dry out and harden quite so readily either.

RAW, NATURAL, & TURBINADO: In recent years, sugar refiners have realized that there is a market for less refined forms of cane sugar in the U.S. and have begun to sell this kind of sugar under various names and packagings. None of it is really raw sugar since it is illegal to sell it in the U.S. due to the high impurities level in the truly raw product. All of it has been processed in some form or fashion to clean it, but it has not been subjected to the full refining and whitening processes of ordinary white table sugar. This leaves some of the natural color and a mild flavor in the sweetener. All of these less refined sugars may be stored and handled like brown sugar.

Outside of the United States it is possible to buy truly raw sugar and it can be found under names such as "muscavado", "jaggery" (usually a raw palm or date sugar), "demerara" and others. With all of the molasses and other impurities retained it is quite strong in flavor so would not be suited to general use, but there are recipes that call for it. In spite of moisture and impurities it can be stored like brown

sugar since its sugar content is high enough to inhibit most microbial growth.

### D.1.1 STORING GRANULATED SUGARS

All granulated sugars have basically the same storage requirements. They need to be kept in air tight, insect and moisture proof containers. For powdered, and granulated sugar you might want to consider using some desiccant in the storage container if your local climate is damp. Since brown sugars and raw sugars are supposed to be moist, they do not need desiccants. Shelf life is indefinite if kept dry, but anything that you intend to eat really should be rotated over time. Time has a way of affecting even the most durable of foods.

I've used brown sugar that was six years old at the time it was removed from storage and, other than the molasses settling somewhat toward the bottom, it was just fine. A friend to whom I gave a bucket of the brown sugar finished it off three years after I gave it to her which was nine years after it was packaged and it, too, was fine.

## D.2 TYPES OF HONEY

Honey is probably the oldest sweetener known to man. Its use predates recorded history and has been found in the Egyptian pyramids. It's typically sweeter than granulated sugar by a factor of 25%-40% depending upon the specific flowers from which the bees gather their nectar. This means a smaller amount of honey can give the same amount of sweetening as sugar. The source flowers also dictate the flavor and the color of the sweetener as well. Honey color can range from very dark (nearly black) to almost colorless. As a general rule, the lighter the color and the more delicate the flavor, the greater the price the honey will bring. As you might expect, since honey is sweeter than table sugar, it also has more calories as well -- 22 per teaspoon compared to granulated sugar's 16 per teaspoon. There are also trivial amounts of minerals and vitamins in the bee product while white sugar has none.

Raw honey may also contain minute quantities of botulinum spores and should not be fed to children under one year of age. PLEASE READ THE POST FROM GERI GUIDETTI CONCERNING THIS BELOW. Raw honey is OK for older children and adults. Honey is not a direct substitute for table sugar however, its use in recipes may call for a bit of alteration to get it to turn out right.

Honey comes in a number of forms in the retail market and they all have different storage characteristics:

WHOLE-COMB: This is the bee product straight from the hive. It is the most unprocessed form in which honey comes, being found as large pieces of waxy comb floating in raw honey. The comb itself will contain many unopened honey cells.

RAW: This is unheated honey that has been removed from the comb. It may contain bits of wax, insect parts and other

small detritus.

FILTERED: This is raw honey that has been warmed to make it more easy to filter out small particles and impurities. Other than being somewhat cleaner than raw honey it is essentially the same. Most of the trace amounts of nutrients remain intact.

LIQUID: This is honey that has been heated to higher temperatures to allow for easier filtering and to kill any microorganisms. Usually lighter in color, this form is milder in flavor, resists crystallization and generally clearer. It stores the best of the various forms of honey. Much of the trace amounts of vitamins, however, are lost.

SPUN or CRYSTALLIZED: This honey has had some of its moisture content removed to make a creamy spread. It is the most processed form of honey.

### D.2.1 BUYING HONEY

Much of the honey sold in supermarkets has been blended from a variety of different honeys and some may have even had other sweeteners added as well. Like anything involving humans, buying honey can be a tricky business. It pays to deal with individuals and brands you know you can trust. In the United States you should buy products labeled U.S. GRADE A or U.S. FANCY if buying in retail outlets. However, be aware there are no federal labeling laws governing the sale of honey, so only honey labeled pure is entirely honey and not blended with other sweeteners. Honey grading is a matter of voluntary compliance which means some producers may be lax and sloppy about it. This can be a real nuisance when producers use words like "organic", "raw", "uncooked" and "unfiltered" on their labels, possibly to mislead. Fortunately, most honey producers are quite honest in their product labeling so if you're not certain of who to deal with, it is worthwhile to ask around to find out who produces a good product.

Honey may also contain trace amounts of drugs used in treating various bee ailments, including antibiotics. If this is a concern to you, then it would be wise to investigate with your local honey producer what has been used.

### D.2.2 STORING HONEY

Honey is much easier to store than to select and buy. Pure honey won't mold, but may crystallize over time. Exposure to air and moisture can cause color to darken and flavor to intensify and may speed crystallization as well. Comb honey doesn't store as well liquid honey so you should not expect it to last as long.

Storage temperature is not as important for honey, but it should be kept from freezing and not exposed to high temperatures if possible.

Either extreme can cause crystallization and heat may cause flavor to strengthen undesirably.

Filtered liquid honey will last the longest in storage. Storage containers should be opaque, airtight, moisture and odor-proof. Like any other stored food, honey should be rotated through the storage cycle and replaced with fresh product.

If crystallization does occur, honey can be reliquified by placing the container in a larger container of hot water until it has melted.

Avoid storing honey near heat sources and if using plastic pails don't keep it near petroleum products (including gasoline/diesel engines), chemicals or any other odor-producing products.

### D.2.3 RAW HONEY AND BOTULISM

From: Geri Guidetti arkinst@concentric.net

Duane Miles wrote:
>If I recall correctly, honey contains very, very small amounts of >the bacteria that cause botulism. For adults, this seldom causes >problems. Our immune system is capable of dealing with small numbers >of even nasty bacteria, they do it all the time. The problem is when >we get large numbers of bacteria, or when our immune system is damaged >or not yet developed.

>That is where the problem with honey comes in. Some people used to >use honey to sweeten milk or other foods for infants. Infants immune >systems sometimes cannot handle the bacteria that cause botulism, and, >of course, those infants became seriously ill. So pediatricians now >advise strongly against using honey for children under a certain age.

Yes, raw honey can contain the temperature resistant spores of "Clostridium botulinum", the bacterium that causes botulism. The organism is a strict anaerobe, meaning that it only grows in the absence of molecular oxygen. The problem with infants and honey is that the small, intestinal tract of an infant apparently is sufficiently anaerobic to allow the spores to germinate into actively growing C. botulinum organisms. Essentially, the infant serves the same role as a sealed, airtight, contaminated can of beans as far as the organisms are concerned. There in the infant's body the bacteria secrete the dangerous toxin that causes the symptoms of botulism. There have been quite a few documented infant deaths due to honey. As I recall, the studies identifying honey as the source were done in the '80s. Most pediatricians recommend no honey for the first year. It is probably best to check with your own for even later updates...Geri Guidetti, The Ark Institute

### D.2.4 HONEY OUTGASSING

Q: My can of honey is bulging. Is it safe to use?

A: Honey can react with the can lining to release a gas especially when stored over a long period of time. Honey's high sugar content prevents bacteria growth. If there is no sign of mold growth, it is

safe to eat. FREQUENTLY ASKED FOOD QUESTIONS, FN250

### D.3 TYPES OF CANE SYRUPS.

MOLASSES & CANE SYRUP: These two sweeteners are not precisely the same thing. Molasses is a by-product of sugar refining and cane syrup is simply cane juice boiled down to a syrup, in much the same way as maple syrup is produced. Non-Southerners (U.S.) may know it better as unsulphured molasses even if this is not completely correct. Sulphured molasses is also available on the market and very cheap as well, but it's strong flavor is unattractive and generally not desirable.

SORGHUM: This is produced in the same manner as cane syrup, but sorghum cane, rather than sugar cane, is used. Sorghum tends to have a thinner, slightly sourer taste than cane syrup.

TREACLE: This sweetener comes in varying colors from a rather dark version, similar to, but not quite the same as blackstrap molasses, to paler versions more similar to golden syrup.

All of the above syrups are generally dark with a rich, heavy flavor.

GOLDEN SYRUP: This syrup seems to be both lighter and paler in color than any of the above three, probably more similar to what we would call a table syrup here in the U.S.

TABLE SYRUP: There are many table syrups sold in supermarkets, some with flavorings of one sort or another such as maple, various fruits, etc. A close examination of the ingredients list will reveal mixtures of cane syrup, cane sugar syrup or corn syrup along with preservatives, colorings and other additives. They usually have a much less pronounced flavor than molasses, cane syrup, sorghum or the darker treacles. Any syrup containing corn syrup should be stored as corn syrup.

#### D.3.1 STORING CANE SYRUPS

All of the above syrups, except for those having corn syrup in their makeup, have the same storage characteristics. They can be stored on the shelf for about two years and up to a year after opening. Once they are opened, they are best kept in the refrigerator to retard mold growth. If mold growth does occur, the syrup should be discarded. The outside of the bottle should be cleaned of drips after each use. Some pure cane and sorghum syrups may crystallize in storage, but this causes no harm and they can be reliquified using the same method as for honey.

### D.4 CORN SYRUP

Corn syrup is a liquid sweetener made by an enzyme reaction with corn-starch. Available in both a light and a dark form, the darker variety has a flavor similar to molasses and contains refiners syrup (a byproduct of sugar refining). Both types often contain flavorings and preservatives. It is commonly used in baking and candy making because it does not crystallize when heated. Corn syrup is very common in the U.S., but less so in the rest of the world.

Corn syrup stores poorly compared to other sweeteners and because of this it often has a best if used by dating code on the bottle. It should be stored in its original bottle, tightly capped, in a cool, dry place. New unopened bottles keep about six months from the date on the label. After opening, keep the corn syrup four to six months. These syrups are very prone to mold and to fermentation so be on the lookout for bubbling or a mold haze. If these present themselves, throw the syrup out. You should always be certain to wipe off any drips from the bottle after every use.

### D.5 MAPLE SYRUP

Maple syrup is produced by boiling down sap of the maple tree until it reaches a syrup consistency and is slightly sweeter than table sugar. Maple syrup is judged by much the same criteria as honey: Lightness of color, clarity and taste. Pure maple is generally expensive and most pancake syrups are corn and cane sugar syrups with either natural or artificial flavorings. Maple flavored pancake syrups should be kept and stored as corn syrups.

New unopened bottles of maple syrup may be kept on a cool, dark, shelf for up to two years. The sweetener may darken and the flavor get stronger, but it is still usable.

After the bottle has been opened, it should be refrigerated. It will last about a year. Be careful to look out for mold growth. If mold occurs, discard the syrup.

## E. FATS AND OILS

All oils are fats, but not all fats are oils. They are very similar to each other in their chemical makeup, but what makes one an oil and another a fat is the percentage of hydrogen saturation in the fatty acids of which they are composed. The fats and oils which are available to us for culinary purposes are actually mixtures of differing fatty acids so for practical purposes we'll say saturated fats are solid at room temperature (70 deg. F) and unsaturated fats we call oils are liquid at room temperature. For dietary and nutrition purposes fats are generally classified as saturated, monosaturated and polyunsaturated, which is a further refinement of the amount of saturation of the particular compositions of fatty acids in the fats.

### E.1 BUYING AND STORING OILS AND FATS

There is a problem with storing oils and fats for the long term and that is the fact that they go rancid rather quickly. Rancid fats have been implicated in increased rates of heart disease, atherosclerosis and are carcinogenic (cancer causing) so we want to avoid them if possible.

Oxygen is eight times more soluble in fat than in water and it is the oxidation resulting from this exposure that is the primary cause of rancidity. The more polyunsaturated a fat is, the faster it will go rancid. This may not, at first, be readily apparent because vegetable oils have to become several times more rancid than animal fats before our noses can detect it. An extreme example of rancidity is the linseed oil (flaxseed) that we use as a wood finish and a base for oil paints. In just a matter of hours the oil oxidizes into a solid polymer. This is very desirable for wood and paint, very undesirable for food.

Because of this difficulty in storing fats and oils for any long period of time many books and articles on the subject of food storage make only passing mention of them, if they say anything at all. This is unfortunate because fat contains nine calories to the gram compared to the four calories contained by either carbohydrates or protein. This makes fat a valuable source of concentrated calories that could be of real importance if faced with a diet consisting largely of unrefined grains and legumes. For small children, infants and the elderly, they may not be able to consume the volume of food that would be necessary in the course of a day to get all of the calories they would need to avoid weight loss and possible malnutrition. Additionally, fats play an important role in our perception of taste and texture and their absence would make many foods more difficult to prepare and consume. Furthermore, a small amount of dietary fat is necessary for our bodies to properly absorb fat soluble vitamins like A,D,E and K.

Long term storage of fats may be problematical, but it is not impossible. There are some general rules you can follow to get the most life out of your stored cooking oils and fats.

#1 Exposure to oxygen, light and heat are the greatest factors to rancidity. If you can, refrigerate your stored oil, particularly after it's been opened. If possible, buy your oils in opaque, airtight containers. If you purchase it in plastic, particularly clear plastic, then transfer it to a gas impermeable glass or metal container that can be sealed airtight. If you have a means of doing so, vacuum sealing the storage container is an excellent idea as it removes most of the air remaining inside, taking much of the oxygen with it. Transparent glass and plastic containers should be stored in the dark, such as in a box. Regardless of the storage container, it should be stored at as cool a temperature as possible and rotated as fast as is practical. Oils and fats with preservatives added by the manufacturer will have a greater shelf life than those without them, provided they are fresh when purchased.

#2 Unless they have been specially treated, unopened cooking oils have a shelf life of about a year, depending upon the above conditions. Some specialty oils such as sesame and flax seed have shorter usable lives. If you don't use a great deal of it, try to not buy your fats in large containers. This way you won't be exposing a large quantity to the air after the you've opened it, to grow old and possibly rancid, before you can use it all up. Once opened, it is an excellent idea to refrigerate cooking fats. If it turns cloudy or

solid, the fat is still perfectly usable and will return to its normal liquid, clear state after it has warmed to room temperature. Left at room temperatures, opened bottles of cooking oils can begin to rancid in anywhere from a week to a couple of months, though it may take several more months to reach such a point of rancidity that it can be smelled.

#3 Although darker colored oils have more flavor than paler colored, the agents that contribute to that flavor and color also contribute to faster rancidity. For maximum shelf life buy paler colored oils.

#4 If you have no particular problem with using it, the culinary fat with the most shelf life as it comes from the store is hydrogenated shortening in its unopened metal or metal lined can. The brand most familiar in the U.S. is probably Crisco, but there are many others. Solid shortening is usually composed of partially hydrogenated vegetable oils, but there are some that also contain animal fats. Some brands will also contain anti-oxidant preservatives as well. All other conditions being equal, those with preservatives will have a longer shelf life than those without. It is not possible to give an exact answer, but it is reasonable to expect an unopened metal can of shortening to have a shelf life of eight to ten years if kept reasonably cool, particularly if it has preservatives in it.

## E.2 EXTENDING SHELF LIFE BY ADDING ANTI-OXIDANTS

If obtaining the maximum shelf life in your cooking oils is important to you, it is possible to add anti-oxidant preservatives to the fat after you have purchased it. Used in conjunction with a gas impermeable container, either opaque in color or stored in a dark place, and cool storage temperatures (70 F or less) then shelf life can be extended to about five years, possibly longer.

The anti-oxidant in question is Butylated HydroxyToluene (BHT). It is used in the food industry to slow the development of off-flavors, odors and color changes caused by oxidation, mostly in foods that are high in fats and oils. BHT is on the U.S. Food and Drug Administration's Generally Recognized As Safe (GRAS) list as a common preservative. The FDA limits the use of BHT to 0.02% or 200 parts per million (ppm) of the oil or fat content of a food product. The directions that I will be giving below will be for the FDA limit, but there are those who choose to use up to ten times that amount as part of their life extension programs. The level you choose is up to you.

BHT is available over the counter in the retail trade, but you have to know where to look for it. The only retail distributor of the anti-oxidant that I am thus far aware of is

Twin Laboratories (TwinLab),
Ronkonkoma, NY 11779.

Their BHT comes in the form of 250 mg gelatin capsules. I've been able to find their product in several local health food stores. It is also available through mail order sources, but I don't have any names or addresses for that avenue yet.

To get the best results you will need the freshest oil you can

find.  Purchasing it from a large, busy supermarket will probably suffice.  You'll also need containers that are gas impermeable such as glass jars, or metal cans.  There may be plastic containers with high gas barrier properties that will also serve, but I cannot knowledgeably say about this.  It is important that your containers are food grade and are clean, dry and dust-free.

Each 250 milligram capsule is sufficient to treat 47 fluid ounces of cooking oil (as per the GRAS guidelines mentioned above).  If you have an accurate means of weighing this works out to be 5.3 mg of BHT crystals to every 1 fl oz of oil.  If you're using a scale calibrated in grains, such as a reloading powder scale, you may use the following table.

| BHT in grains | OIL | BHT in milligrams |
|---|---|---|
| 0.1 grain | 1 fl oz | 5.3 mg |
| 0.7 grain | 8 fl oz (1 cup) | 42.4 mg |
| 1.3 grain | 16 fl oz (1 pint) | 84.8 mg |
| 2.6 grain | 32 fl oz (1 quart) | 169.6 mg |
| 5.2 grain | 64 fl oz (1/2 gal) | 339.2 mg |
| 10.3 grain | 128 fl oz (1 gal) | 678.4 mg |

NOTE:  The grain weight measurements have been rounded up to the nearest tenth grain since most powder scales will not accurately measure less than one-tenth of a grain.

IMPORTANT NOTE:  If you are using a reloading powder scale, be sure the balance pan is clean and the balance has been calibrated recently with a reliable set of check weights.

Remove the BHT crystals from their gelatin capsules and weigh, if you're going to.  Once you have the appropriate amount, add the crystals to a pint or so of the oil, shaking vigorously.  It may take several hours for the preservative to dissolve completely.  Bringing the oil up to a warm, NOT HOT, temperature will speed the process.  Once completely dissolved, pour the anti-oxidant laden oil into the rest of the oil and mix thoroughly.  Once mixed, the oil can then be poured into its storage containers leaving approximately 1/2 inch of headspace.  If you have a vacuum sealer the jars or cans may be vacuum sealed to remove most of the oxygen from the container, otherwise just seal the lid.  Store in a cool place and if using transparent jars, be certain to put them in a larger container such as a box to keep the contents in the dark.  Don't forget to label and date the jars.

There are other preservatives in food industry use that will also work, but I have not yet discovered how they are used or where to get them.  I'm currently looking for information on Butylated HydroxyAnisole (BHA), propyl gallate, vitamin E (the tocopherols, natural and synthetic), ascorbyl palmitate (a fat soluble form of vitamin C), citric acid and mono-Tertiary-ButylHydroQuinone (TBHQ).  Additionally, certain herbs and spices like cloves, rosemary, oregano, sage and vanilla also have antioxidant properties, sometimes quite strong ones.  Being strongly flavored, they are not suitable as preservatives in fats meant for general use, but will lend their protective properties in any recipes that call for them.

Before I close out this section on fats and oils, please allow me to reemphasize that no amount of preservatives that can be added to your stored fats will substitute for proper storage and rotation. The more I research the chemistry and physiological effects of rancid fats the more I come to believe they are bad news for long term health, particularly as we grow older. Don't sit on your oil supply for years without rotating it. Just a little bit rancid is just a little bit poisonous. `Nuff said.

## F. COOKING STAPLES

### F.1 BAKING POWDER.

This powder is a combination of an acid and an alkali with starch added to keep the other two ingredients stable and dry. The powder reacts with liquid by foaming and the resulting bubbles can aerate and raise dough. Almost all baking powder now on the market is double acting, meaning it has one acid that bubbles at room temperature and another acid which only reacts at oven temperatures. Unless a recipe specifies otherwise, this is the type to use.

Don't expose baking powder to steam, humid air, wet spoons, or any other moisture. Store in a tightly lidded container for no more than a year. Even when kept bone dry it will eventually loses its potency. To test its strength, measure 1 tsp powder into 1/3 cup hot water. The mixture should fizz and bubble furiously. If it doesn't, throw it out.

For those folks concerned with aluminum in the diet, the Rumford brand has none in it and there may be others.

### F.2 BAKING SODA.

This gritty powder is sodium bicarbonate also called sodium acid bicarbonate ($NaHCO_3$), a mild alkali. It is used in baking to leaven bread and other baked or fried foods and does so in the same manner as baking powder. It can also be used to make hominy. When combined with an acid ingredient, the bicarbonate reacts to give off carbon dioxide bubbles which causes the baked good to rise. If kept well sealed in an air- and moisture-proof container its storage life is indefinite. If kept in the cardboard box it usually comes in, it will keep for about eighteen months. Do keep in mind that baking soda is a wonderful odor adsorber. If you don't want your baked goods tasting of whatever smells it adsorbed then keeping it in an airtight container is an excellent idea.

### F.3 HERBS AND SPICES.

It is difficult to give exact instructions on how best to store culinary herbs and spices because there are dozens of different seeds, leaves, roots, barks, etc., we call an herb or a spice. There are, however, some general rules to be followed to best preserve their flavors. All spices, particularly dried, are especially sensitive to heat, air and light. Room temperature is satisfactory for keeping them and refrigeration or freezing is even better, but they should be kept

away from heat sources. It is common for the household spice cabinet or shelf to be located over the stove, but this is really a very poor place. Dark opaque glass is best for storage, but failing that, keeping a tightly sealed glass container in a dark place is next best. The cellophane packets some products come in just won't do. Tightly sealed metal containers will work as well. Even dense plastic will do, but glass is best.

Where possible, buy spices whole. Whole nutmegs will keep their flavor far longer than ground nutmeg, the same for other seeds and roots. You'll have to use a grater, grinder or whatever, but the difference in flavor will be worth it.

If you buy spices in bulk containers (which is certainly cheaper) consider transferring some into smaller containers and keeping the larger one tightly sealed in a cool, dark place. This will prevent unwanted light and air from continually getting in and playing havoc.

Included in the suppliers addresses are listings for several spice and herb companies. The one I have personally dealt with so far is Penzey's and their products have been consistently excellent with good prices. It's worth investigating some of these companies as they can really take the sting out of purchasing large quantities.

F.4 SALT.

Storage life for salt is indefinite. So long as you do not let it get contaminated with dirt or whatever, it will never go bad. Over time, iodized salt may turn yellow, but this is harmless and may still be used. Salt is rather hygroscopic and will adsorb moisture from the air if not sealed in an air-tight container. If it does adsorb moisture and cakes up, it can be dried in the oven and then broken up with no harm done.

All salt, however, is not the same. Salt comes in a number of different varieties, and very little of what is produced in the U.S. is intended for use in food. The rest of it, about 98%, has other uses. Therefore, it is important to be certain the salt you have is intended for human consumption. Once you are satisfied it is, you should then determine its appropriateness for the tasks to which you might want to set it to. Below is a partial list of some of the available salts

TABLE SALT: This is by far the most widely known type of salt. It comes in two varieties; iodized and non-iodized. There is an ingredient added to it to adsorb moisture so it will stay free flowing in damp weather. This non-caking agent does not dissolve in water and can cause cloudiness in whatever solution it is used if sufficiently large quantities are used. In canning it won't cause a problem since there is very little per jar. For pickling, though, it would be noticeable. If you are storing salt for this purpose, you should be sure to choose plain pickling salt, or other food grade pure salt such as kosher salt. In the iodized varieties, the iodine can cause discoloration or darkening of pickled foods so be certain not to use it for that purpose. For folks who come from areas that are historically iodine deficient a store of iodized salt for table consumption is of real importance.

CANNING SALT: This is pure salt and nothing but salt. It can usually be found in the canning supplies section of most stores. This is the salt to be preferred for most food preservation or storage uses. It is generally about the same grain size as table salt.

KOSHER SALT: This salt is not really, in itself, kosher, but is used in "kashering" meat to make the flesh kosher for eating. This involves first soaking the meat then rubbing it with the salt to draw out the blood which is not-kosher and is subsequently washed off along with the salt. The cleansed meat is then kosher. What makes it of interest for food storage and preservation is that it is generally pure salt suitable for canning, pickling and meat curing. It is of a larger grain size than table or canning salt, and usually rolled to make the grains flaked for easier dissolving. Frequently it is slightly cheaper than canning salt and usually easier to find in urban/suburban areas.

NOTE: Not all brands of kosher salt are exactly alike. Diamond Crystal Kosher Salt is the only brand that I'm aware of that is not flaked, but still in its unaltered crystal form. The Morton brand of Coarse Kosher Salt has "yellow prussiate of soda" added as an anti-caking agent. Morton still recommends it for pickling and even gives a kosher dill recipe on the box so I presume that this particular anti-caking agent does not cause cloudiness in pickling solutions.

Whether flaked or in its unaltered crystal form, kosher salt takes up more volume for an equivalent amount of mass than does canning salt. If it is important to get a very precise amount of salt in your pickling or curing recipe you may want to weigh the salt to get the correct amount.

SEA SALT: This type of salt comes in about as many different varieties as coffee and from about as many different places around the world. The "gourmet" versions can be rather expensive. In general, the types sold in grocery stores, natural food markets and gourmet shops have been purified enough to use in food. It's not suitable for food preservation, though, because the mineral content it contains (other than the sodium chloride) may cause discoloration of the food.

ROCK or ICE CREAM SALT: This type of salt comes in large chunky crystals and is intended primarily for use in home ice cream churns to lower the temperature of the ice filled water in which the churn sits. It's also sometimes used in icing down beer kegs or watermelons. It is used in food preservation by some, but none of the brands I have been able to find label it as food grade nor do they specifically mention its use in foods so I would not use it for this purpose.

SOLAR SALT: This is also sometimes confusingly called "sea salt". It is not, however, the same thing as the sea salt found in food stores. Most importantly, it is not food grade. It's main

purpose is for use in water softeners. The reason it is called "solar" and sometimes "sea salt" is that it is produced by evaporation of sea water in large ponds in various arid areas of the world. This salt type is not purified and still contains the desiccated remains of whatever aquatic life might have been trapped in it. Those organic remains might react with the proteins in the foods you are attempting to preserve and cause it to spoil.

HALITE: For those of us fortunate enough to live in areas warm enough not need it, halite is the salt that is used on roads to melt snow and ice. It, too, is not food grade and should not be used in food preservation. This form of salt is also frequently called rock salt, like the rock salt above, but neither are suitable for food use.

SALT SUBSTITUTES: These are various other kinds of metal salts such as potassium chloride used to substitute for the ordinary sodium chloride (NaCl) salt we are familiar with. They have their uses, but should not be used in foods undergoing a heated preservation processing, as they can cause the product to taste bad. Even the heat from normal cooking is sometimes sufficient to cause this.

## F.5 VINEGAR.

There is vinegar and then there is vinegar and it is not all alike. The active ingredient in all vinegars is acetic acid, but how the sour stuff was made can vary widely. The most common vinegar is white distilled which is actually just diluted distilled acetic acid and not true vinegar at all. It keeps pretty much indefinitely if tightly sealed in a plastic or glass bottle with a plastic cap. The enamel coated metal caps always seem to get eaten by the acid over time. It is usually about 5-6% acetic acid and for pickling it is the type most often called for.

The next most common variety is apple cider vinegar. There are two kinds of this type. A cider flavored distilled acetic acid type and a true cider vinegar fermented from hard cider. Either will store indefinitely at room temperature until a sediment begins to appear on the bottom. Stored vinegar will sometimes develop a cloudy substance. This is called a mother of vinegar and it is harmless. As long as the liquid does not begin to smell foul it can be filtered out through cheesecloth or a coffee filter and rebottled in a clean container. The mother can even be used to make more vinegar. If it begins to smell bad, however, it's gone over and should be tossed out.

The more exotic wine, balsalmic and other vinegars can be stored like cider vinegar. Age and exposure to light and air, however, eventually begin to take their toll on their delicate flavors. Tightly capped in a cool, dark cabinet or refrigerator is best for their storage.

## F.6 YEAST.

Yeast is just not a product you can stow away and forget about

until you need it next year.  It is, after all, a living organism and if it's not alive at the time you need it, you won't get any use out of it. This ancient leavening, brewing, fermenting agent is a single celled microscopic fungus.  When we incorporate it into our bread dough, beer wort or fruit juice it begins to reproduce madly (we hope) and produce several by-products.  If you're baking, the by-product you want is carbon dioxide which is trapped by the dough and subsequently causes it to rise.  In brewing or vintning what is wanted is the ethyl alcohol and, if the drink is to be carbonated, the carbon dioxide as well.

Almost all yeasts used for these purposes are in the same genus ("Saccharomyces" or sugar fungi), but several different species have evolved and some are more suitable for a particular task than others. It's entirely possible to use grocery store bread yeast to brew beer or ferment wine, but the results may leave a great deal to be desired. It's also possible to use yeast from beer brewing to make bread and from what I've read the results were pretty much indistinguishable from bread yeast.

Leaving aside the brewing and vintning yeasts which are really outside the scope of this FAQ I am going to concentrate on bread yeast. It comes in two generally available forms; compressed or fresh and dried, sometimes called granular or instant active dry yeast.  They are different genetic strains of the same species, and have different characteristics.

Compressed yeast is only partly dried (about 70% moisture) and requires refrigeration and keeps even better in the deep freeze.  If kept in an air- and moisture-tight container to prevent it from desiccating this type of yeast will keep for a year in the freezer (0 deg. F or less), but only about two weeks (maybe a bit more) in the refrigerator.  Unless your kitchen is rather chilly it will not keep on the shelf.  It should not have a mottled color or a sour odor.

Dried yeast has only an 8% moisture content and comes packed in foil envelopes.  The smaller single use packets are not generally vacuum packed, but the larger commercial sized "bricks" of about a pound or two each generally are.  They can last for months on the shelf, until the expiration date which should be clearly stamped on the package.  If packaged in the same manner as recommended for compressed yeast above and kept in the refrigerator or freezer it can last for several years. The larger packs of yeast should be transferred to an air and moisture tight container after opening.

Either type of yeast can be tested for viability by proofing it. This is nothing more than mixing a small amount of the yeast with an equal amount of sugar in warm water (105-115 deg. F for dried;  95 deg. F for fresh).  Within about five minutes active yeast will become bubbly and begin to expand (at normal room temperature).  Yeast which only slowly becomes active can still be used, but you will have to use more of it.  If it shows no activity at all, it's dead and should be thrown out.

There is another means of providing yeast for baking besides buying it from the grocery store and that is by using a sourdough starter.  I'm not going to address it here, but I will point out that it has a newsgroup all its own (rec.food.sourdough) and several FAQ's devoted to it.  You can find addresses for these FAQs in the Resources section.

Drop in and read for awhile and you'll learn more than you thought you could ever want to know.

G. INFANT FORMULA

Since most folks interested in food storage are planning for families, real or as yet hypothetical, I thought it important to include something on infant formula. Most baby food that comes in jars can be treated like canned goods of similar types meant for adults. Formula, though, is something else. I have to admit, that not yet having kids of my own, I've not given this much thought before so the below is taken from the book KEEPING FOOD FRESH, by Janet Bailey (see book list). In the future, if some of you readers will send it to me and/or I come up with more information from my own researches I want to expand this section on infant/child food storage.

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Prepared infant formula is primarily water and nonfat cow's milk. Among other ingredients, it contains sweeteners; sometimes lactose which is milk sugar; and sometimes corn syrup or other sugars. Coconut and soybean oils are common; vitamin and mineral supplements are universal. A few brands contain mono- and diglycerides, chemicals that keep the liquid from separating.

BUYING AND STORING INFANT FORMULA. Canned liquid infant formula comes either ready to eat or in a concentrate to be diluted with water. Cans and packing cases are clearly marked with a "use by" date.

Unopened cans stored in a cool, dry place keep well from twelve to eighteen months (longer than the baby is an infant).

After the can is opened, measure out the amount of formula you need, cover the can and store in the refrigerator. It will keep no more than 48 hrs at 40 deg. F. Never return leftover formula from the bottle to the storage container and do not store half used bottles.

You can pre-measure the whole can-full into sterilized baby bottles, seal them, and store them in the refrigerator, but forty eight hours is still the limit. To keep full bottles from tipping over in the refrigerator, slip them into a carton from a six-pack of soda pop bottles.

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In examining the offerings at my local grocer I see that infant formula is also offered as a dry powder to be mixed by the parent. I could not come to a ready idea of how long the formula powder might be good on the shelf since it seemed to vary radically depending on exact type and manufacturer. The shortest use-by date was only a year, but some had use-by dates three years into the future. Clearly, this is an area that is going to need much investigation. I hope some of our knowledgeable readers out there will be able to help out.

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## -- III --
## SPOILAGE

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# A -- INSECT INFESTATIONS

## A.1 PESTS OF STORED GRAINS, LEGUMES AND DRY FOODSTUFFS

Insect infestations can occur in a wide variety of foodstuffs such as flours, meals, pastas, dried fruits and vegetables, nuts, sweets, whole grains, beans, sugars, TVP, jerky, bird seed and pet foods.

Naturally, the best way to deal with an insect infestation is not to have one in the first place. Try to purchase from suppliers who are clean and have a high volume of turnover of their products. This will mean the products you purchase will be less likely to have bugs in them.

When you buy foodstuffs examine them closely to be sure they are insect free. Check for any packaging or use by dates to insure their freshness. Don't shake the package, most adult insects will be found in the top couple of inches of the product and shaking the package will mix them into the contents and disguise them. If the package does turn out to be infested, return it for replacement.

Once you have purchased the product you should store it in an air- and moisture-tight container so it cannot be invaded after you have brought it home. With sufficient time, adult and some larval insect forms can penetrate paper, cardboard and thin plastic packaging. Your containers should be either heavy plastic, glass or metal with tight fitting lids. As with everything in food storage, you should use older packages before newer ones and opened packages before unopened ones.

The storage area should be kept clean. Don't allow grain, flour, beans, bits of pasta or other food particles to accumulate on shelves or the floor. Cracks and crevices should be sealed or otherwise blocked. Unless it is a sticky spill, vacuuming is the best method of cleaning since cleaning with soap and water can wash food particles into the cracks.

Insects may get their start in chairs, sofas and carpets where food is dropped and not cleaned up. Don't forget to replace the filter bag on the vacuum since some insects can survive and reproduce in the bag after they've been sucked into it.

Bags of dry pet food and bird seed can also harbor insect infestation. Decorative foodstuffs such as ears of colorful Indian corn, colored beans and hard squashes can carry insects that can infest your edible food. Even poison baits can harbor flour beetles.

## A.2 CONTROL OF INSECT INFESTATIONS

Should you find that in spite of buying fresh products and using careful packaging techniques you have an insect infestation, you can try some of the following steps:

1. If the food is too heavily infested to try to save it should be disposed of as soon as possible. Remove it from the kitchen or food storage area immediately so it won't infest other foods.

2. Large bugs can be sifted or winnowed out if the food's not too heavily infested and you want to try to save it. Then treat it by placing into a deep freezer at 0 deg. F for three to seven days depending upon the size of the package. Refrigerator freezers usually do not freeze low enough to effectively kill all of the life stages of insects, but if left there, will slow their development. If freezing is not workable then the product could be spread on baking sheets and heated to 150 deg. F for fifteen to twenty minutes, cooled and repackaged. Heat treated foods should be consumed shortly thereafter.

3. The surface areas where the food containers are stored can be treated with an insecticide. This is not a replacement for clean storage habits and good containers, but it can supplement it. This will not control insect infestations already in your stored foods.

Spray the shelf surface with 0.5% chlorpyrifos (Dursban), 1% propoxur (Baygon), 0.5 percent diazinon, or 0.25 percent resmethrin. You can find any of these in the hardware store in ready to apply packages. If a sprayer isn't feasible then they can be applied with a paint brush. Allow the solution to dry thoroughly. Cover the shelves with clean, untreated shelf paper and put properly packaged foods back on shelves. READ THE PRODUCT LABEL FOR SAFETY INFORMATION CONCERNING CHILDREN AND PETS.

Household bleach, Lysol and other sterilizers will not control insect infestation, though they can be used for mold, mildew and algae.

You may continue to find some insects after the cleanup is finished. This could be for several reasons. The first being they escaped from the packages they were infesting and did not get cleaned up. There may be more packages infested than were originally realized or, there may be hiding places in the storage area that need attention. Once you have carefully eliminated all food sources, the bugs should disappear in three to four weeks.

## B -- MOLDS IN FOOD

Molds are fungi just like mushrooms and yeast. Also like mushrooms, they reproduce by releasing spores into the air that land on everything, including your food and food storage containers. If those spores begin to grow, they create thin threads that spread through out their growing medium. These threads are the roots of the mold fungus, called "mycelium". The stalk of a mold fungus is the portion above or on the surface of the food. It produces the spores and gives the mold its color. We've all seen examples of this when we discover a dish of something or other left way-y-y too long in the refrigerator and has become covered in mold fuzz.

Molds can grow anywhere they have a growing medium (their food), sufficient moisture and enough warmth. Some can even grow at refrigerator temperatures, albeit more slowly than they would if it were warmer. They can also withstand much more salt and sugar than bacteria, which is why you sometimes find mold in jellies and jams with their high sugar content and on cured products like ham or bacon with their high salt content.

In the past, it was often felt a slight amount of mold was harmless

and the food could be consumed anyway. For molds that were intentionally introduced into the food, such as the mold in bleu cheese, this is just fine. For the unintentional molds, it can be a very serious error in judgment. These unwanted molds might just be producing a toxic substance called a "mycotoxin" which can be very bad indeed. Mycotoxins are produced around the root or mycelium of the mold and the mold roots can penetrate very deeply into the food. These mycotoxins can survive for a long time in foods, and unfortunately most are not destroyed by cooking. The molds probably best known for this are the various Aspergillus varieties which produces a mycotoxin known as "aflatoxin", but there are other dangerous molds as well, such as the Fusarium molds. Both of the above affect grain and some legumes. See B.3 Molds In Grains and Legumes.

IMPORTANT NOTE: In wet pack foods such as your home canned goodies, molds can do something else as well, possibly leading to lethal consequences. If they find their way into wet pack acid foods canned by the boiling water bath method, whether by reasons of improper procedure or contamination after the fact, they can consume the natural acids present in the food. The effect of this is to raise the pH of the food in the container, perhaps to the point that it becomes possible for spores of *Clostridium botulinum*, better known as "botulism", to become active and reproduce. If you're not already aware of the consequences of botulism poisoning, please read the bacterial spoilage section below where it has an entry all its own. This is the most deadly kind of food poisoning there is. For this reason, moldy wet pack foods should be *safely* discarded.

Molds in low acid foods canned by the pressure canning method are equally dangerous and should also be discarded in a safe manner.

## B.1 MINIMIZING MOLDS

You can do a number of things to minimize unwanted mold growth in your kitchen, food storage areas and refrigerators. If your kitchen is at all like mine, it is the refrigerator that is going to collect the most fungal growth. This can be dealt with by washing the inside every couple of months with a tablespoon of baking soda dissolved in a quart of warm water. Rinse clean and allow to dry. The black mildew that grows on the rubber door gaskets and other places can be dealt with by wiping down with a solution of three tablespoons of household bleach in a quart of water. I generally use a soft bristle brush for this.

The rest of the kitchen can be kept mold free by keeping it clean, and dry and by spraying occasionally with a product such as Lysol. Patches of mold growing in spots can be eliminated with the bleach solution used on the refrigerator doors.

Try not to purchase more fresh food than you'll be able to eat in a short period of time. This will keep you from having to deal with the moldy remains that didn't get eaten. If food does go moldy, don't sniff it. This is a good way to give yourself respiratory difficulties if you are at all susceptible to mold allergies. Moldy food should be disposed in such a manner that your animals and children won't be able to get into it. Mycotoxins are every bit as bad for your animals as they are for you.

Obviously, you don't have to throw out everything that shows a spot of mold on it. Some foods can be safely dealt with and still partially saved if they show signs of fungal growth. Below is a set of guideline from M. Susan Brewer, Ph.D., R.D., a specialist in food safety. Her articles and works are found in many state university extension services publications lists.

If the food shows even a tiny mold spot, follow these guide lines:

1. Hard or firm foods with tiny mold spots can be trimmed; cut away the area around the mold (at least an inch) and rewrap in clean wrap. Make sure that knife does not touch the mold.

2. Soft foods such as cheese slices, cream cheese, sour cream and yogurt should be thrown away.

TOSS:

Soft Cheeses, (Mozzarella, Brie, etc.)
Sour Cream, Yogurt, Cottage cheese
Bacon, Hot dogs, Sliced lunch meats
Meat pies
Opened canned ham
Most left-over food
Bread, Cakes, rolls, flour, pastry
Peanut butter
Juices, berries
Jam, Jellies, Syrups
Cucumbers, Tomatoes
Spinach, Lettuce, other leafy vegetables
Bananas, Peaches, Melons
Corn-on-the-cob
Stored nuts, whole grains, rice

TRIM:

Hard Cheese (Cheddar, Swiss, etc.)
Bell Peppers, Carrots, Cabbage
Broccoli, Cauliflower, Brussels Sprouts
Garlic, Onions
Potatoes, Turnips
Zucchini
Apples, Pears

## B.2 MOLDS IN CANNED GOODS

If good equipment and proper technique are used, then it is unlikely you will ever have mold growth in your unopened canned goods. If you do have such, then there was either a flaw in the procedure you used, or something affected the jar or can after the fact to break its seal. In any event, once the food has molded, it is past saving and should be discarded in such a way that children and animals will not be able to get into it. The most likely home canned products to show mold growth are jams and jellies sealed with paraffin wax.

There are a number of points in the canning process where this can occur:

(1) In the time after the jar is taken out of its boiling water bath, but before it is filled.

(2) In the time between when the jar is filled and covered with the melted wax.

(3) When the wax cools, if it pulls away from the side of the jar, leaving an opening for the mold to get in.

(4) If bubbles form in the paraffin, which break and leave holes.

It is for this reason that most canning authorities no longer recommend using this technique. If you must use it, the jelly jars should be boiled for at least 10 minutes before the jelly is poured into the jars. The filled and wax capped jars should then be covered with some sort of protective lid. The book, Putting Food By has excellent instructions on this or see the applicable section of the rec.food.preserving FAQ by Leslie Basel.

## B.3 MOLDS IN GRAINS AND LEGUMES

It's long been known that eating moldy grain is bad for your health. The ugly consequences of eating ergot-infected rye probably make the best known example. It's only been for about thirty years, though, that intensive study of these grain fungi have been carried out on other varieties of molds and their respective mycotoxins. Fortunately, for those of us in the U.S., the USDA and the various state departments of agriculture go to a great deal of trouble to detect grain and legumes infected with these toxic fungi. In some of the less developed countries, the citizenry are not so lucky. Still, it is good to have something of an understanding of what one should do to prevent mold growth in one`s stored grains and to have an idea of what to look for and ask about when purchasing grains and legumes.

The one fungal type that has caused the most commotion in recent history are the various "Aspergillus" species of molds. Under certain conditions with certain grains, legumes, and to a lesser extent, nuts, they can produce a mycotoxin called "aflatoxin". This is a serious problem in some parts of the world, most especially in peanuts, occasionally in corn. I am not aware of any documented deaths in the United States from aflatoxicity, but other nations have not been so fortunate. What makes aflatoxin so worrisome in this country is that it is also a very potent carcinogen (cancer causing agent).

In addition to the Aspergillus molds, there is also a very large family of molds called "Fusarium" and these can produce a wide variety of mycotoxins, all of which you do not want to be eating directly or feeding to your food animals where you will get the toxins back indirectly when you eat them.

The Federal government and the various state governments continuously monitor food and forage crops. Those products which are prone to mold growth and toxin production are not allowed to be sold for food. Once purchased however, it is up to you to keep your food safe

from mold growth. If you have already found mold growth in your whole grains, meals, flours or other grain products, they should be discarded. Most mycotoxins are not broken down or destroyed by cooking temperatures and there is no safe way to salvage grain that has molded.

### B.3.1 PREVENTING MOLD GROWTH IN STORED GRAINS AND LEGUMES

The easiest method to prevent mold growth in your stored grains and legumes is simply to keep them too dry for the mold to grow. The Aspergillus and Fusarium molds require moisture contents of 18% and above to reproduce. This is subject to some variability, but in all grains and soybeans, they must have a moisture content of that level. If you are storing raw (not roasted) peanuts, in the shell or shelled, you want to get the moisture content to less than 8% as peanuts are particularly susceptible to mold growth. The recommended moisture content for all other grain and legume storage is no more than 10%. *Please see part 2.A.3.1 Grains and Legumes for a method to determine moisture content.* At 10% moisture, it is simply too dry for fungi to grow. *Please see 1.A.4 Storing Grains and Legumes for a suitable packaging technique.*

## C -- BACTERIAL SPOILAGE

Just like the fungi, bacteria are everywhere. They're in the water, soil, air, on you, your food and your food storage containers. Fortunately, the vast majority of the bacteria we encounter are relatively harmless or even benign and only a few represent a danger to us and our stored foods.

Bacteria can be very much more difficult to kill off than molds and insects. Some of them are capable of continued growth at temperatures that would kill other spoilage organisms. When conditions are such that they are unable to grow, some bacteria can go dormant and form spores. These spores can be quite hardy, even to the point of surviving a rolling boil.

In order to grow, bacteria need moisture, some as little as a 20% moisture content. For dry grains, legumes, powdered milk and other low moisture foodstuff bacterial spoilage will seldom be a problem so long as the moisture level in the foodstuff remains too scant to support its growth. For this reason, it is imperative that such products be drier than 20% and preferably below 10% to ward off mold growth as well. The botulism bacterium needs moisture in the 35% range to grow. Thus, making being sure of the moisture content of the food products you want to store, and appropriately using desiccants in your food packaging are also excellent ideas.

WARNING: It is in wet pack canned goods (where the container has free liquid in it) and fresh foods we must be the most concerned about spoilage bacteria. It is here that a little bad luck and a moment's inattention to what you are doing could kill or seriously injure you or some other person who eats the foods you've put by. In both home-canned and commercially-canned goods, IF THE CAN IS BULGING, LEAKING, SMELLS BAD, OR SPEWS LIQUID WHEN YOU OPEN IT THEN THROW IT OUT! But, throw it out safely so that children and animals cannot get into it.

## C.1 BOTULISM

*Clostridium botulinum* is one of the oldest life forms found on the planet. Like the gangrene bacteria, it is an anaerobic organism meaning it lives and grows in the absence of free oxygen. It forms spores when conditions are not suitable for it to grow and it is commonly found in the soil. This means it can be brought into your life on raw produce, tools, hands or anything else that came into contact with dirt. To further complicate matters, botulinum spores are extremely heat-hardy. The bacteria itself can be killed by exposing them for a short time to boiling water (212 deg. F AT SEA LEVEL PRESSURE), but their spores can not. To kill them, the food product and container must be exposed to temperatures of 240 deg. F (AGAIN AT SEA LEVEL PRESSURE) for a long enough period of time to allow all of the food in each container to come completely up to the proper temperature. Only a pressure- canner can reach the necessary temperature.

It's not the bacteria or its spores which are directly deadly, but the toxin the bacteria creates when it grows and reproduces. In its pure form, botulism toxin is so potent that a mere teaspoon of it would be enough to provide a fatal dose to hundreds of thousands of people. It is this lethality that is why every responsible book on canning, food preservation, food storage, and the like hammers constantly on the need for care in technique and method and why spoilage must be taken so seriously.

C. botulinum, like any other life form, must have suitable conditions for it to grow and become a danger to you. One of the conditions it must have is a suitable pH range in its environment. pH is the measure of the acidity or alkalinity of a substance and is measured on a scale of 1-14 with anything above 7 being considered alkaline and everything below 7 being considered acid. If the pH of your wet pack food is BELOW 4.6 then botulism is unable to grow. Keep in mind pH is not eternal in foods and it is possible for it to change. If it should change to a lesser acidity than 4.6 pH your previously botulinum proof food may start allowing the lethal spoiler to grow (see B.2, molds in canned goods). This is why it is vital to use proper technique, even for acid foods like tomatoes. It has been found that when this occurs and botulinum becomes active and produces its lethal toxin it also produces minute amounts of acid which can lower the pH of the poisoned food back into what should have been the safe zone had the pH not jumped up and allowed the bacteria to grow. Again and again -- use good technique and pay attention to what you are doing.

Botulinum toxin, unlike fungal mycotoxins, can be destroyed by boiling the food briskly in an open vessel for fifteen minutes. Because of this, if your canned food shows any safety problems you should follow this procedure. If the food shows even the slightest mold growth, keep in mind that mycotoxins are not for the most part broken down by heat and dispose of the food safely.

I don't intend to go into the hows of home canning here. For that I strongly recommend that you read the *r.f.p. FAQ*, the *Ball Blue Book* and most especially the book *Putting Food By* for in depth information on this subject.

C.2 OTHER BACTERIAL SPOILERS OF FOOD

This section will be in a future version of this FAQ.

## D -- ENZYMATIC ACTION IN FOOD SPOILAGE

Every living organism uses enzymes of many sorts in its bodily functions as part of its normal life cycle. Enzymes are used in creating life. After death, enzymes play a role in the decomposition of once living tissue. The enzymes in a tomato help it to ripen and enzymes produced by the tomato and whatever fungal and bacterial spoilers are on it cause it to decay.

Fortunately, slowing down or stopping the action of a food's enzymes is much easier to do than slowing or stopping some of the bacterial spoilers mentioned above. Enzymes are most active in a temperature range between 85-120 deg. F and begin to be destroyed when the temperature goes above 140 deg.F. Cold also slows down the action of enzymes, which is why fresh tomatoes last longer in the refrigerator than they do on the kitchen table. Most enzymatic action also requires moisture to occur. In foods stored at 10% moisture or less, there is not enough moisture for most enzymes to be active.

# ========== -- IV -- SPECIFIC EQUIPMENT QUESTIONS ==========

## A -- STORAGE CONTAINERS

A.1 WHAT IS FOOD GRADE PACKAGING?

Q: OK, I'm ready to start my storage program. What should I put the food in?

A: You should use food grade packaging for storing anything you intend to eat. A food grade container is one that will not transfer noxious or toxic substances into the food it is holding. If you are uncertain whether a package type is food grade you can contact the manufacturer. Ask if that particular container is (US) FDA approved meaning that it is safe for food use. When inquiring be sure to specify the characteristics of the food you are storing; wet, dry, strongly acidic or alkaline, alcoholic or a high fat content. A container that is approved for one of the above types of food may not be approved for another.

The major functions of a food storage container are to:

#1. Protect its contents from outside environmental influences such as moisture, and oxygen, but possibly also heat or cold, light, insects and/or rodents as well.

#2. Prevent damage during handling and shipping.

#3. Establish and/or maintain microbiological stability. The container should not allow microorganisms such as fungi and bacteria from outside the container to come into contact with its contents. This is of critical importance to wet-pack foods such as canned vegetables, fruits and meats.

#4. Withstand the temperatures and pressures it will be exposed to. This is necessary if the contents are to be pasteurized or sterilized, either immediately before or after filling. It must not have any structural failures nor release any noxious or toxic breakdown chemicals into the food it contains. This is the reason why purpose built canning jars are recommended for home canning and mayonnaise jars aren't. The former are made heavier to withstand high temperatures and handling whereas the latter are not and have an increased risk of breakage if used for that purpose.

Virtually all containers used in home food preservation involving exposure to high temperatures are made of glass or metal, with the exception of some specialized "heat & seal" type of plastic bags. Glass can be used with any food type providing it is clean and in sound condition, but metal cans are more specialized. They must be intended for food use and must also have a lining or coating of the inside that is suitable for the pH level of the food it will be in contact with.

If the foods are not subjected to some form of heat processing just before or after packaging your selection of container types for home use is a great deal larger. Virtually any kind of clean, sound glass jar can be used and many types of new metal containers. Several sorts of plastics have become popular. These various kinds of plastics are each suited for different purposes, making selection a more complex task.

### A.1.1 WHERE DO I FIND FOOD GRADE CONTAINERS?

Food grade packaging is everywhere. Every time you go into the grocery store you are surrounded by it. Many well known companies such as Tupperware and Rubbermaid manufacture and sell empty packaging for the express purpose of containing repackaged foods. The kinds of containers you are interested in and the types of foods you want to put in those containers will dictate where you need to look for a particular packaging system.

For food storage purposes most folks are usually interested in five and six gallon plastic pails, glass jars from pint to gallon sizes, metal containers such as the institutional sized #10 cans, and Mylar or other high barrier property plastic bags. Those are the containers most often used, but virtually anything that can protect foods from outside environmental influences, safely contain something you're going to later eat and have a volume capacity large enough to be worthwhile may be used.

A number of food storage retailers such as those listed in the Resources section sell plastic buckets, Mylar bags and a few even sell new #10 cans with lids. It may also be possible to purchase #10 cans through the LDS Family Canneries and dealers such as Lehman's Hardware Cumberland General Store or Home Canning Specialty and Supply. On the local scene, plastic five gallon buckets are widely available, but only if you purchase them through a restaurant or commercial foods supply

house will you likely be able to tell if they're safe to keep food in. If you can locate a customer service number for the manufacturer you can call them and ask. Many times manufacturers will make products that are FDA approved and sell them as general purpose containers, but you need to call to be sure.

Packaging supply houses, such as United States Plastics and others, have large FDA approved packaging lines. Several such companies are listed in the Resources section and a bit of detective work can probably turn up more. Some require minimum orders and others don't. The cost of shipping the containers will probably play a major role in your decision making. If you are going to package a great deal of food all at once, perhaps for a group of people, some of the companies that require minimum purchases can sometimes save you a fair amount of money and supply packaging you might otherwise have a difficult time finding. Some time spent searching the Thomas Register, available both online (http://www12.thomasregister.com ) and in library reference sections, might turn up some valuable leads.

For glass jars, don't overlook flea markets, yard sales, thrift shops and similar places. Canning jars can sometimes be had for very little. Delicatessens, sub shops and restaurants of all sorts can be a source of one gallon glass jars formerly containing pickles, peppers, etc. If the lids are still in good condition, they are well suited to bulk storage and can be reused over and over.

Metal cans, by and large, are not reusable for good storage, but some companies might be able to sell you new cans. The traditional single use #10 can is only the beginning of what might be available with a little looking. Gallon sized or larger cans with double friction lids (like paint comes in) make excellent storage containers and some companies make them food safe. One gallon and larger cans with wide diameter screw caps are available from some companies as well. You might have seen some of these holding edible oils, soy sauce, honey and other liquid food. If they come with a cap that will seal air tight they would be well suited for bulk storage of grains and legumes, particularly if they come in a four to six gallon size.

Pick up you local phone book, log on to your favorite search engine or head to your local public, college or university library and explore the possibilities. Make it clear that what you want must be FDA approved and be up front about how many you need or can deal with. If one company won't deal with you, try another. You'll eventually get what you want.

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From: Denis DeFigueiredo ddefig@newhall.com
Originally posted in: rec.food.preserving

I called Berlin [eds. note, a plastic container mfgr.] 1-800-4-BERLIN and spoke to them, plus an outfit called Kirk Container (they manufactured some 5 gallon paint buckets I saw in the local hardware store). Both places said that buckets made from High Density PolyEthelene (HDPE) are approved for food. It has to do with the possibility of interaction between any chemicals in the food and the plastic. As it turns out, Kirk manufactures only one kind of bucket, and then markets it for paint, hardware, food, etc. The price is right on the "paint buckets" - much cheaper than the local restaurant supply

house.

High density polyethelene buckets will have HDPE stamped on them, or a recycle symbol with a "2" in the middle.

DISCLAIMER: I'm only passing on information I received from the manufacturers. I am in no way professing these things to be absolute fact!

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From: "Jenny S. Johanssen" johanssen@matnet.com
Originally posted in: rec.food.preserving

Denis - saw your comments on food grade buckets and thought I'd offer my solution. My son cooks at a local Mexican restaurant. They get all their strawberries (for the strawberry magaritas at the bar) in 3 gallon plastic buckets. Now you know how many margaritas pass through a Mexican bar each night - lots. So I asked my son to save me some buckets. They are ideal for storing flour, rice, I made (from my home grown raspberries) a delicious raspberry cordial in one of the buckets, another I made Raspberry wine in. My motto is why buy when you can recycle! Thanks for giving me the time and space to add my two-bits worth. - Jenny

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From: Woody Harper lager@primenet.com
Originally posted: rec.food.preserving

...I get topping buckets from Dairy Queen and I have to make sure there is no trace of the strawberry syrup left. A little detergent and elbow grease followed by a chlorine solution bath keep everything nice and clean.--

## A.2 PLASTIC PACKAGING

Before we can intelligibly discuss plastic packaging it is necessary to understand what the substance we call "plastic" is. Plastics are produced from basic polymers called "resins", each of which have differing physical properties. Additives may be blended in to color them or to modify particular properties such as moldability, structural properties, resistance to light or heat or oxidation. Additionally, it is common for several different kinds of plastic to be laminated together each performing a particular desired task. One might offer structural rigidity and the other might be more impermeable to the transfer of gasses and odors. When bonded together a rigid, gas impermeable package can be made.

Whether that package is safe for food use will depend on the exact nature of the additives blended into the plastic. Some of them, notably plasticizers and dyes, can migrate from the packaging material into the food it's containing. This may be exacerbated by the nature of the food it's in contact with especially if it is high fat, strongly acidic or alcoholic in particular. Time and temperature may also play a prominent role in the migration of plastic additives into food. For this reason, the (US) FDA assesses the safety of packaging materials for food contact

and conducts toxicological studies to establish safety standards. Only plastics that are FDA approved for a particular food type should be used for direct contact with that food.

Just being FDA approved, however, may not be all of the story. It must still be determined whether the particular plastic in question has the physical properties that would make it desirable for your purpose.

As mentioned above each base resin has somewhat differing physical properties that may be modified with additives or combined by laminating with another plastic or even completely unrelated materials such as metal foils. An example of this is "Mylar", a type of polyester film. By itself, it has moderate barrier resistance to moisture and oxygen. When laminated together with aluminum foil it has very high resistance and makes an excellent material for creating long term food storage packaging. One or more other kinds of plastic with low melting points and good flow characteristics are typically bonded on the opposite side of the foil to act as a sealant ply so that the aluminized Mylar can be fashioned into bags or sealed across container openings. The combined materials have properties that make them useful for long term storage that each separately do not have.

Probably the most common plastic that raises suitability questions is High Density PolyEthylene (HDPE). It's used in a wide array of packaging and is the material that most plastic five and six gallon buckets are made of. It has a moderate rigidity, a good resistance to fats, oils, moisture and impacts, a fair resistance to acids, but is a poor barrier to oxygen.

Whether it is suitable for your purpose depends on how sensitive to oxygen exposure your product is and how long you need it to stay in optimal condition. Foods such as whole grains are not particularly delicate in nature and will easily keep for years in nothing more than a tightly sealed HDPE bucket. Most legumes are the same way, but those that have high fat contents such as peanuts and soybeans are more sensitive to O2. Other foods such as dry milk powder might only go a year before deleterious changes are noticed. If that milk were sealed in an air-tight aluminized Mylar bag with the oxygen inside removed, the milk would probably go for two years or more. Better still would be to seal the milk in a metal can or glass jar. HDPE can still be used for long term storage, but with one or more of the following precautions to keep a high food quality: The food should either be put on a shorter rotation cycle than packaging also using a second gas barrier such as Mylar; be periodically opened and re-purged or fresh absorbers should be inserted.

Some special plastics and plastic laminates have excellent oxygen and moisture barrier properties and are eminently suited to long term storage, but for home use they are not easy to find, though some used containers might be available for reuse..

### A.2.1 HOW DO I GET THE ODOR OUT OF PICKLE BUCKETS?

I've had fairly good luck doing it in the following way. Since vinegar is the primary smell in pickles and it's acidic, we used a base to counteract it. First we scrubbed the bucket well, inside and out, with Dawn dish detergent. Most any sort will do. Then we filled the

buckets with hot water and dissolved a cup of baking soda in each. Stir well, get the bucket as full as you can and put the top on. Put the bucket in the sun to keep it warm so the plastic pores stay open as much as possible. In a couple of days come back and empty the buckets. Rinse them out, fill with warm water again and add about a cup of bleach and reseal. Put back in the sun for another couple of days. Empty out and let dry with the tops off. We completely eliminated the vinegar smell this way. It might be possible to cut the time down a lot, but we haven't experimented that much since we can't get that many pickle buckets.

## A.3 METAL CANS

Metal cans and glass jars being heat resistant, can both be used for heat processed, wet-pack foods and for non-heat treated dry pack canning. For wet foods, however, metal cans have several disadvantages for the do-it-yourselfer. They are hard to come by, and they take specialized equipment to use that can be difficult to locate. Probably the greatest flaw which makes them unpopular for home canning heat processed wet-pack food is that they can only be used once. Since the commercial canning industry is not interested in reusing the containers, metal cans make great sense for their purposes. The cans are both cheaper (for them) and lighter than glass jars. This adds to the economy of scale that makes canned foods as cheap as they are in the grocery store.

For home canning, wet-pack heat processed foods glass jars are better because even the smallest of towns will usually have at least one business that carries pressure and boiling water canners along with jars, rings and lids. With metal cans a can sealer is necessary and this usually has to be ordered from the manufacturer or a mail-order distributor. A few of which are listed in the Resources section.

Metal cans are not really made entirely of tin. They're actually steel cans with a tin coating on the inside and outside. Some kinds of strongly colored acidic foods will fade in color from long exposure to tin so a type of enamel liner called "R- enamel" is used to forestall this. Certain other kinds of food that are high in sulfur or that are close to neutral in pH will also discolor from prolonged contact with tin. For those foods, cans with "C-enamel" are used.

The excellent food preservation book, *Putting Food By* Chapter 6 (see reference list) has a section on the use of metal cans for wet packed foods.

It is in dry-pack canning that metal cans for home use begin to come into their own. Because microbiological sterilization isn't necessary, foods that are dry packed into containers do not have to be subjected to heat processing nor does the safety of their seals depend upon the vacuum that the cooling contents create. This means that other packaging methods and container types may be used.

Probably the most common use of metal containers is the #10 cans such as are used by the LDS family canneries discussed below. This is not the only way they may be used though. It will probably take a bit of searching, but there are various food grade metal containers available of sufficient volume to make them useful for food storage.

They usually have double friction lids similar to paint cans or screw caps like jars that can achieve an air-tight seal. If you can find them in a large enough volume capacity they can be of real use for storing bulky foods such as grains, legumes and sugar. Smaller cans of a gallon or less would be useful for storing items like dry milks. If properly sealed, metal cans have a far higher barrier resistance to gasses such as oxygen, CO2, and nitrogen than any plastic.

Although they can hardly be considered portable the use of metal drums (not garbage or trash cans), either themselves food grade or used with food grade liners, is also a possibility. A fifty five gallon drum full of grain will weigh several hundred pounds, but may make for a much easier storage solution than multiple buckets. The advantage of using such a large container is that a great amount of a single product can be kept in a smaller amount of space and fumigating or purging the storage atmosphere would be simpler. The disadvantages are the difficulties of moving it and rotating the stock in the drum. If using oxygen absorbers make sure the drum you want to use is capable of making an air-tight seal, otherwise you should stick with carbon dioxide fumigation.

### A.3.1 POOLING RESOURCES: THE CHURCH OF JESUS CHRIST OF LATTER DAY SAINTS -- THE MORMONS

Although the purchase of a can sealer and metal cans for home use is not economically feasible for most people there is one way that it can be. This is by pooling community resources to purchase the equipment and supplies. It may even, in fact, not be necessary to form your own community to do this. If you live in the right area your local Latter Day Saints church may have facilities they will allow you to use. They may even have suitable food products to sell you. This is an offshoot of the church's welfare programs and it is done in their family canneries. Rather than using plastic buckets they have gone over to using metal cans church-wide for dry-pack canning. By sharing the cost of the equipment and purchasing the cans in bulk quantities, they are able to enjoy the advantages of metal cans over plastic containers while minimizing the disadvantages of cost. As we approach the end of the Millennium, other groups, both religious and secular, are purchasing can sealers in order to facilitate their own food storage programs as well.

*Please see VI.F.1 Organizations. The Church of Jesus Christ of Latter Day Saints -- LDS Family Canneries for more detailed information about where LDS Family Canneries may be found and how best to approach using them.*

Any food products you want to have sealed in cans will need to fall within the LDS cannery guidelines of suitability for that type of packaging. This is for reasons of spoilage control since many types of foods just aren't suitable for just sealing in a container without further processing. If you purchase food products from them, they will already be within those guidelines. *A brief treatment of these guidelines may be found in VI.F.1 LDS Family Canneries Guidelines.*

Once you have your foodstuffs on hand, either supplying your own or by purchasing them from the cannery you're ready to package them. It is here that using some forethought concerning your packaging system can save you much time and aggravation. With the Millennium coming upon us the traffic load of the canneries is really beginning to pick up. This

means that access time to the can sealers and other equipment may be limited.

IMPORTANT NOTE: Please do keep in mind that the individuals responsible for the family canneries are all *volunteers* with demands on their time from many areas. Be courteous when speaking with them and, if there are facilities for use, flexible in making arrangements to use them. You will, of course, have to pay for the supplies that you use, cans and lids at the least, and any food products you get from them. With the onset of the millennium the LDS family cannery volunteers are becoming quite busy so be prepared to have to work with their available scheduling. As a general rule they cannot put your food in storage for you. Be ready to pay for your purchases in advance, if necessary. They do not take credit cards and probably cannot make change so take a check along with you.

The following is a list of suggestions to make the most efficient use of your access time:

#1 - Make your appointment well in advance. Many people are beginning to make use of the canneries so making advanced reservations is a must.

#2 - Have enough people to set up an assembly line type operation. Make sure each of your people knows what they need to do and how to do it. At least four people for any serious amount of food is a good number. Ask the cannery volunteer to go over the process with you and your crew.

#3 - Make sure you have enough muscular helpers to do the heavy lifting so you don't wear yourself out or hurt your back. Some of the supplies you will be working with, such as wheat, come in fifty pound bags and a box of #10 cans full of sugar or other weighty items are heavy.

#4 - Make labels for the foods you are going to pack in advance. This will save time after the cans are filled.

#5 - Take out only as many as oxygen absorbers as you can seal up in a half hour. They use up most of their capacity within two to three hours depending on temperature and humidity. You don't want them to waste any by soaking up the oxygen in the room. The ones you don't use up right away should be tightly sealed in a gas proof container.

#6 - Save powdery food items such as dry milk powder, pudding mixes and grain flours and meals till last. They can be messy to can and this will keep them out of your other foods.

#7 - Leave time to clean up after yourself. They are doing you the courtesy of using their equipment and selling you the supplies at cost. You should return the favor by leaving the place at least as clean as you found it.

#8 - Always keep in the back of your mind just how much volume and weight your vehicle can carry. You'd hate to find you canned more than you could carry home.

*See also IV.C.2 Preventing Corrosion of Canned Goods.*

## A.4 GLASS JARS

Compared to metal cans, glass jars are very stable, although they obviously don't take being banged around very well. The cardboard boxes most jars come in are well designed to cushion them from shocks. The box also has the added bonus of keeping damaging light away from food.

The major advantage of glass jars is that they are reusable. For wet-pack canning the lids must be replaced, but the rings don't. For dry pack canning even the lids may be reused probably indefinitely.

When you get right down to the bottom line, it is seldom practical strictly in terms of dollars and cents to wet-pack your own food in jars. When you count the cost of your equipment, including the jars, rings, lids and all the rest, along with a not inconsiderable amount of your personal time, the cost of purchasing or growing your produce, you'll almost always come out ahead to buy food canned for you by the commercial canning industry. That said, forget about the strict bottom line and examine more closely why you want to put up your own food. For many, gardening is a pleasure and they have to have something to do with the food they've grown! There's also the fact that for many, you simply cannot buy the quality of the food you can put up for yourself. The canning industry tries to appeal to a broad spectrum of the general public while you can put up food to your own family's specific tastes. Home canning is not so much about saving money as it is about satisfaction. You get what you pay for.

If home canning appeals to you, please allow me to point you toward the *rec.food.preserving FAQ* where much very good information about methods and techniques may be found.

Dry-pack canning using glass jars, on the other hand, may well make a great deal of economic sense. It is usually far cheaper per pound to purchase food in bulk quantities, but often unsuitable to store it that way. Breaking the food down into smaller units allows for easier handling and exposes a smaller quantity of food to oxygen and moisture before it can be used up. Of course, packaging used for doing this can be made of many different materials, but glass is often the easiest and most convenient to acquire and use. Used containers are frequently suitable and are often free or of little cost. One source of gallon sized glass jars are sandwich shops and restaurants that use pickles, peppers and other sandwich condiments. I have a Subway sandwich shop that saves its pepper jars for me and receive several per week. There are also half-gallon canning jars, though they are sometimes difficult to find. The brand I buy is made by Kerr.

## A.5 MYLAR BAGS

The word "Mylar" is a trademark of the DuPont corporation for a special type of polyester film. Typically made in thin sheets, it has a high tensile strength and is used in a wide variety of industrial settings.

In food storage, particularly for the long term, it is commonly found as a laminate with Mylar as the top layer, a very thin aluminum foil in the middle and one or more other types of plastic films on the bottom acting as sealant plies. This laminate combination possesses a high resistance to the passage of oxygen, carbon dioxide, nitrogen, other gasses and water vapor and is what makes it valuable for our purposes. Unfortunately, it has a poor puncture resistance so it must be used as an interior liner for more puncture resistant containers rather than as a stand- alone package.

Food grade aluminized Mylar complies with US FDA requirements and is safe to be in contact with all food types except alcoholic.

For food use, Mylar is most commonly available as pre-made bags of various sizes. Flat sheets or rolls of the material might also be found from which bags could be fashioned as well.

When Mylar bags are used by the storage food industry they are generally for products sealed in plastic buckets. The reason for doing this is that the High Density PolyEthylene (HDPE) from which the pails are made is somewhat porous to gasses. This means that small molecules, such as oxygen (O2), can slowly pass through the plastic and come into contact with the food inside. The problem is further compounded if oxygen absorbers are used, as the result of their absorbing action is to lower the air pressure inside the container unless it has first been carefully flushed with an inert gas such as nitrogen. How fast this migration activity will occur is a function of the specific plastic formulation, its wall thickness and the air pressure inside the container. In order to gain the maximum possible shelf life a second gas barrier, the Mylar bag, is used inside the pail.

Whether the use of these bags is necessary for your home packaged storage foods depends on how oxygen sensitive the food item is and how long you want it to stay fresh. If the container is made of a gas impervious material such as metal or glass then a second gas barrier inside is not needed. If it is HDPE or a plastic with similar properties and you want to get the very longest possible storage life (say 10+ yrs for grain) then Mylar is a good idea. If you're going to rotate that grain in four to five years or less then it is not needed. Provided the oxygen has been purged from the container in the first place, either with a proper flushing technique, or by absorption, there will not have been sufficient O2 infiltration to seriously impact the food. Particularly oxygen sensitive foods such as dry milk powders that are to be kept in plastic containers for more than two years would benefit from the use of Mylar. Naturally, storage temperature and moisture content is going to play a major role as well.

There is also the question of the seal integrity of the outer container. If you are using thin walled plastic buckets in conjunction with oxygen absorbers the resulting drop in air pressure inside the pail may cause the walls to buckle. If this should occur, there would be a risk of losing seal integrity, particularly if the buckets are stacked two or more deep. If the food was packed in Mylar bags with the absorbers inside this would keep the vacuum from seriously stressing the container walls. Better still would be not to have the problem at all by either using containers of sufficient wall thickness or flushing with inert gas before sealing. Wall thickness is one reason why the six gallon SuperPails have become so widespread. It should be noted that

Mylar is not strongly resistant to insect penetration and not resistant at all to rodents. If mice chew through your buckets, they'll go right through the bags.

A number of retail dealers carry Mylar bags. Contact information may be found in the suppliers section.

### A.5.1 HOW DO I USE MYLAR BAGS?

Sealing food in Mylar bags is a straight-forward affair, but it may take a bit of practice to get it right, so purchase one or two more bags than you think you'll need in case you don't immediately get the hang of it.

#1 - The bags typically sold by storage food dealers look rather large when you compare them to the five or six gallons buckets they are commonly used in. That extra material is very necessary if you are to have enough bag left over after filling to be able to work with it. Unless you are very sure of what you are doing, don't trim off any material.

#2 - Place the bag inside the outer container and fill with the food product. Resist filling it all the way to the top. You need at least an inch or so below the bucket rim left open to get the lid to seat completely.

#3 - When it seems to be full, gently thump the pail on the floor a few times to pack the product in and reduce air pockets. Add any makeup food necessary to bring level back to where it should be.

#4 - Take the bag by the corners and pull out any slack in the material so that all sides can be pulled together evenly. Place your oxygen absorbers inside if you are going to use them. Now place a board over the top of the bucket and fold the bag end down over it keeping it straight and even. Place a piece of thin cotton fabric such as sheet or t-shirt material over the edge of the bag mouth. Using a clothes iron set on the cotton, wool or high setting run it over the cloth-covered Mylar about a half-inch from the edge for about twenty seconds or so until it seals. You'll probably have to do the bag in sections. Experimenting on a left-over strip to find the right temperature setting is a good idea.

#5 - When you've done the entire mouth of the bag allow it to cool. Once cool try to pull the mouth of the bag open. If it doesn't come open, fold the bag down into the pail until you feel the trapped air pillowing up firmly against the material and wait to see if it deflates. If it doesn't, then your seal is good. You can seal on the bucket lid at this point or take the further step to vacuum or gas flush the bag.

Once a seal has been obtained the bags can be left as-is, vacuum sealed or gas flushed. To obtain the most efficient oxygen removal the bags can be first drawn down with a vacuum pump and then purged using an inert gas.

VACUUM SEALING MYLAR BAGS

Once you have obtained a good seal on the bag, pulling a vacuum on the contents is also pretty straight forward.

First you'll need something to make a vacuum with. This can be either a regular vacuum pump, a vacuum sealer such as the Tilia Food Saver or even the suction end of your household vacuum cleaner. The end that is to be inserted into the bag will need to be of fairly small diameter in order to keep the hole in the Mylar from being any larger than necessary. This means that if you use a vacuum cleaner you'll need to fashion some form of reduction fitting.

Cut a hole into the Mylar bag on a corner, making the opening only just large enough to admit the vacuum probe. Insert the nozzle and using a sponge, or something similar, push down on the material over the probe to make a seal. Now draw down a vacuum on the bag. It will probably only take a second or two. When it's drawn down as much as possible, run a hot iron diagonally across the cut corner resealing the bag.

GAS FLUSHING MYLAR BAGS.

Flushing with inert gas works essentially just like vacuum sealing except that you're putting more gas into the bag rather than taking it out. You'll want to keep the entry hole small, but don't make a seal around it as above. Beyond that, follow the directions as given in Section IV.B.2 - $CO_2$ and Nitrogen. When you feel that the bag has been sufficiently flushed, run the iron across the corner just as above to seal.

Flushing with dry ice can also be done, but it is important to wait until the frozen carbon dioxide has completely sublimated into gas before making the final seal otherwise the bag will burst like an overfilled balloon.

A.6 REUSING OR RECYCLING PACKAGING

In an effort to save money or because new packaging may be hard to come by, it is common for many people to want to re-use previously used containers. There is nothing wrong with this, but it is sometimes more complicated than just using new containers would be. Here are some general "rules of thumb" that can be used if you have an interest in doing this.

#1. Do not use containers that have previously contained products other than food. There are two risks this can expose you to. The first is that the particular package type may not have been tested for food use and may allow the transfer of chemicals from the packaging into your food. The second is that all plastics are porous to some degree. Small amounts of the previous contents may have been absorbed by the packaging material only to be released into your food, particularly if it is wet, oily or alcoholic.

#2. Previously used containers should only be used with foods of a similar nature and exposed to similar processes. This means that if a container previously held a material high in fat, such as cooking oil, then it should not be used to store a strong acid such as vinegar. Nor should a container be exposed to extreme conditions, such as heat, if the original use of the package did not subject it to that treatment. An exception to this is glass which is covered below. Generally speaking, dry, non-oily, non-acidic or alkaline, non-alcoholic foods may be safely contained in any food safe container. An example of this is keeping grains and legumes in HDPE buckets formerly containing pickles.

#3. Glass may be used to store any food provided it is in sound condition and has only been used to store food previously. The lid or cap, however, that seals the jar is subject to the cautions given above. Glass jars not specifically made for home canning, either boiling water bath or pressure canning, have a significant risk of breakage if used for that purpose.

#4. Porous packaging materials such as paper, cardboard and Styrofoam should not be reused. Their open texture can trap food particles and are very difficult to adequately clean. Packaging formerly holding raw meats or shelled egg products are particularly at risk.

#5. Containers previously holding odorous foods may trap those odors and transfer them to foods later stored. Trust me, pickle flavored milk leaves a lot to be desired. Foods such as dry milk powders, fats and oils, flours and meals will absorb any odors seeping from your container material. Be sure to get the smell out before you fill them.

## B -- CO2 AND NITROGEN

Carbon dioxide (CO2) and nitrogen (N2) are commonly used in packaging both fresh and shelf-stable foods, in order to extend their usable shelf lives. Fresh foods are outside the scope of this work so attention shall be focused only on those foods suitable for use in storage programs.

The most common use of these gasses is for excluding oxygen (O2) from the atmosphere contained inside of a storage container (called head gas). When oxygen levels can be dropped below 2% the amount of deleterious oxidation reactions in stored foods can be greatly decreased resulting in longer palatability and nutritional shelf lives. Actually achieving this low oxygen content is not a simple matter when limited to the equipment and facilities typically available in the home. With careful technique and proper packaging materials it is possible to achieve useful results though.

In order for either gas to be used most effectively to gain the longest possible shelf life it is recommended that it be contained inside of packaging with high barrier properties to prevent it from

diffusing out over time or allowing oxygen to infuse in. Examples of this kind of packaging are Mylar and other high barrier property plastics, metal cans and glass jars. Buckets made of HDPE plastic are poor gas barriers and will, over time, allow oxygen to infuse into the container. In order for foods to be kept for their maximum shelf lives the containers would need to be re-purged every three to four years. Foods that are particularly oxygen sensitive, such as dry milk powders, should not be stored in HDPE without a secondary gas barrier. It is possible to use HDPE buckets alone when gas purging if a shorter rotation period is used. An example would be using wheat in four to five years instead of the eight to ten that would be achievable if a high barrier container were used.

Purging efficiency can be greatly improved when used with a vacuum device. By first drawing down the head gas of the container and then flooding with the purging gas much more oxygen can be removed from the container. Repeating the process once more will improve removal efficiency even more. If a true vacuum pump is not available, the suction end of a home vacuum-cleaner can be made to serve and still achieve useful results. With careful technique, oxygen levels can be dropped to be 0.5-2%. Finely textured materials such as grain flours and meals, dry milk powders and similar textured foods will purge poorly and are better packaged with oxygen absorbers. Instructions for vacuum usage are given in *A.5.1 Using Mylar Bags.* Instructions for gas purging are given below in *B.1 Dry Ice and B.2 Compressed Nitrogen*.

A less common, but important use for carbon dioxide is fumigation. This is the killing or retarding of insect life contained in a product. Many chemical fumigants are available to do this but are not thought desirable by many who have foodstuffs they want to put into storage. CO2 is not as certain as the more toxic fumigants, but it can be made to work and will not leave potentially harmful residues behind. It is possible for nitrogen to work in a similar manner, but it must be in a head gas concentration of 99%+ whereas carbon dioxide can be effective over time at levels as low as 3%. The precise amount of time necessary for the gas to do its work will vary according to the specific species and growth stage of the insect along with the temperature and humidity level of the product being fumigated. In general, the more active the growth stage and the warmer the temperature the more effective CO2 is in killing weevil infestations. The gas also exhibits bacterial and fungal inhibiting properties, but for our purposes this will be of little moment since all foods should be too dry to support such growth in the first place.

The procedure for fumigating foodstuffs with carbon dioxide is precisely the same as the one used in purging oxygen from storage containers mentioned below. The only change is that for the fastest effectiveness the sealed container should be left in a warm place for a week or so before moving it into its final storage location. The gas is still effective at cooler temperatures, but because insect life is slowed by lower temperatures the carbon dioxide takes longer to complete its mission.

NOTE: Both Mitsubishi Gas-Chemical, maker of the Ageless line of oxygen absorbers, and Multisorb, manufacturer of the FreshPax D 750 absorbers, state the their products should not be used in a high carbon dioxide head gas environment.

## B.1 DRY ICE

Using dry ice to displace oxygen from food storage containers is a very straightforward affair. To get the best purging results it is recommended that all foodstuffs and packaging materials be put in a warm location for a few hours before beginning the purging process. The reason for this is that the cold $CO_2$ sublimating from the dry ice will be denser than the warmer, lighter oxygen containing air. The cold gas will tend to stay on the bottom, gradually filling the container and pushing the warm air out of the top.

When you first pick your dry ice up from the supplier, put it in a moisture proof container so that water vapor will be less able to condense and freeze on it. The sublimating gas will prevent you from being able to tightly seal it, but you can slow down any water ice accumulation.

Assemble the container and any interior packaging materials. Break off a piece of dry ice of sufficient size for the volume to be purged. One pound of dry ice will produce about 8.3 cubic feet of carbon dioxide gas so approximately four ounces per five gallon bucket will do. Wipe off any accumulated water frost which should look whiter than the somewhat bluish frozen gas. Wrap in a paper towel to keep foodstuffs out of direct contact. Place in the bottom of the container that will actually contain the food, i.e. the bag. Fill the package with the food product, shaking and vibrating while doing so to achieve the maximum packing density.

If a vacuum process is not to be used then place the lid on the container, but do not fully seal. If a liner bag is being used then gather the top together or heat seal and cut off a small corner. This is to allow the air being purged to escape as it is pushed upward by the expanding gas from the dry ice. Do not move or shake the container while the ice is sublimating so as to minimize turbulence and mixing. After approximately two hours complete the seal. Check the container every fifteen minutes or so to be sure that a pressure build up is not occurring. A small amount of positive pressure is OK, but do not allow to bulge.

If a vacuum process is used then cut off a corner of the bag and insert the probe or place the container in the vacuum chamber. Draw a vacuum and when it has reached the desired point shut it off, but do not allow air to get back inside. When the dry ice has finished sublimating seal the container. If a slightly larger piece of dry ice is used this process may be repeated once more to improve oxygen removal. Watch for pressure signs as above.

NOTE: It is natural for some grains and legumes to adsorb carbon dioxide when stored in a atmosphere with high levels of the gas. This will result in a drop in head space air pressure much like using oxygen absorbers will cause as they absorb oxygen. Precautions should be taken in thin walled containers against buckling and possible loss of seal integrity. When the food products are removed from the container they will release the adsorbed $CO_2$ and suffer no harm.

WARNING: Dry ice (frozen carbon dioxide) is extremely cold and can cause burns to the skin by merely touching it. Because of this you

should wear gloves whenever handling it. Also, dry ice evaporates into carbon dioxide gas, which is why we want it. $CO_2$ is not inherently dangerous, we breath it out with every breath we take, but you should make sure the area you are packing your storage containers in is adequately ventilated so the escaping gas will not build to a level dangerous enough to asphyxiate you.

IMPORTANT NOTE: Because dry ice is very cold, if there is much moisture in the air trapped in the container with it, and your food, it will condense. Try to pack your containers on a day when the relative humidity is low or in an area with low humidity, such as in an air-conditioned house. Use of a desiccant package when using dry ice to purge storage containers may be a good idea.

### B.1.1 DRY ICE SUPPLIERS

Dry ice may be found at ice houses, welding supply shops, some ice cream stores, meat packers or you could look in your local phone book under the headings "dry ice" or "gasses".

## B.2 COMPRESSED NITROGEN

### B.2.1 TYPES OF AVAILABILITY

Both nitrogen ($N_2$) and carbon dioxide ($CO_2$) are commonly available in the form of compressed gas in cylinders. In food storage, $CO_2$ is mainly used in the form of dry ice (see above) which is often easier to acquire with much less equipment needed to use it. Because of this, I'll be limiting this section to the use of compressed nitrogen. If for some reason you prefer to use compressed $CO_2$ the information given below will work for it as well, though cylinder sizes may differ.

In the U.S. there are about eight principal suppliers of compressed gasses: Air Liquide, Airco, Linde, Air Products, Matheson, Liquid Carbonic, MG Industries, and Scott. One or more of these producers should have compressed gasses available in virtually every area of the United States and Canada.

Locating a source of compressed nitrogen is probably as easy as looking in your local phone book under the headings "compressed gas suppliers", "gasses", or "welding supplies". Other sources might be automotive supply houses, university or college research departments, vo-tech schools, and medical supply houses.

Nitrogen is generally available in a number of forms ranging from gas intended for welding, to various purity assured types, to gas mixtures where $N_2$ would be one of the components.

Unless you are very knowledgeable about compressed gasses and the equipment needed to use them it is strongly recommended that you not use any gas mixtures in your food storage, but rather to stay with pure nitrogen gas. Use of compressed gas mixtures requires knowledge and equipment beyond the scope of this FAQ.

IMPORTANT NOTE: Welding nitrogen is essentially a pure gas, but it

has one important caveat. When a cylinder of welding gas is used there is an unknown possibility that some form of contaminant may have backfed into the cylinder from a previous user. Possibly this could happen if the tank was being used in an application where the cylinder's internal pressure fell low enough for pressure from whatever the tank had been feeding to backflush into the cylinder. Alternatively, the tank pressure may have become depleted and was repressurized using ordinary compressed service air. The most likely contaminants will be moisture, carbon monoxide, carbon dioxide, oxygen and hydrocarbons, but there is the remote possibility of something even more exotic or toxic getting into your cylinder. Welding gas cylinders may not be checked by the gas supplier before being refilled and sent back out for use. It is this remote, but unknown possibility of contamination that causes me to recommend against the use of welding grade nitrogen in food storage. If your supplier is willing to certify that welding gas cylinders are checked before refilling then they would be OK to use.

The varying types of purity assured nitrogen gas are slightly more difficult to find and slightly more expensive in cost, but I believe this is more than made up for by the fact you know exactly what you're getting. Air Liquide, as an example, offers seven types of purity assured nitrogen ranging from 99.995% to 99.9995% pure with none having a water vapor content over 1 part per million (ppm) or an oxygen content over 3 ppm. Any of them are eminently suited to the task so the most inexpensive form is all you need buy.

As you might expect, compressed gas cylinders come in a number of different sizes. For the sake of simplicity I will address only the most common cylinder sizes since they will almost certainly be the most inexpensive as well.

Again using Air Liquide as an example, it is their size 44 and 49 cylinders that are the most common. There are other cylinder sizes of smaller physical dimensions and capacities. However, the logistics of compressed gas production and transport being what they are, they frequently will cost as much or even more than the larger, more common sizes. The actual gas inside the cylinder is fairly cheap. Filling and moving the heavy cylinders around is not.

Table 1. Air Liquide most common cylinder sizes.

| Cyl Size | Capy Cu Ft | Filled PSIG | Wt Lbs | Ht In | Dia In |
|---|---|---|---|---|---|
| 44HH | 445 | 6000 | 339 | 51 | 10 |
| 44H | 332 | 3500 | 225 | 51 | 10 |
| 49 | 304 | 2640 | 165 | 55 | 9.25 |
| 44 | 234 | 2265 | 149 | 51 | 9 |
| 16 | 77 | 2000 | 71 | 32.5 | 7 |

Legend:

The "H" suffix means high pressure.

PSIG = Pounds per Square Inch on the Gauge, this does not reflect

atmospheric pressure which would be Pounds per Square Inch Absolute (PSIA). PSIA is the absolute pressure of atmospheric and internal cylinder pressure combined.

Although it is not a very common size, I left the #16 cylinder in the above table in case someone really wants or needs to use a smaller cylinder.

.....

Table 2. Cylinder Size Comparison. Abbreviated table.
(Alphagaz in Column 1)

| Cyl Size | Airco | Air Prod | Linde | Liq Carb | Math | MG Ind | Scott |
|---|---|---|---|---|---|---|---|
| [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] |
| 49 | 300 | A | T | J | 1L | 300 | K |
| 44L | 200 | - | K | H | 1A | 200 | A |
| 44 | 200 | B | - | - | - | - | - |
| 44H | - | BY | 3K | - | 1H | 2HP | - |
| 44HH | 500 | BX | 6K | - | 1U | 3HP | - |
| 16 | 80 | C | Q | M | 2 | 80 | B |

Legend:

[1] Alphagaz (Air Liquide)
[2] Airco
[3] Air Products
[4] Linde
[5] Liquid Carbonic
[6] Matheson
[7] MG Industries
[8] Scott

Reference: High Purity Specialty Gases and Equipment Catalog; copyright 1995, Air Liquide America Corporation, Houston TX USA; pages 6 and 7.
.....

As you can see, the size 49 cylinder from Air Liquide has an equivalent from all eight manufacturers. This size is the one commonly seen being used to fill helium balloons at county fairs and ball games.

### B.2.2 OBTAINING THE GAS AND NECESSARY EQUIPMENT

Although you can purchase your own cylinder the most inexpensive way to use nitrogen is to rent a cylinder from your gas supplier. This may require filling out an application, paying a refundable cylinder

deposit and buying the gas contained in the cylinder. Tank rental periods can vary, but the most common is for thirty days.

Having rented or purchased the cylinder you must now get it home. Delivery by the supplier can often be arranged or they may assist you in getting the cylinder into your vehicle. The preferred method of transportation is for the cylinder to be chained, clamped or otherwise solidly secured in a vertical position in the transporting vehicle with the cylinder cap in place. Transportation requirements vary from nation to nation, state to state and even city to city so your best bet is to inquire of your gas supplier to find a safe and legal means of moving the tank.

IMPORTANT NOTE: The major expense in using compressed gas is not the cost of obtaining the gas itself, but in the equipment needed to safely handle and control it. Unless you can borrow the appropriate mechanisms they will have to be purchased, new or used, and even the cheapest regulator and gauge are not inexpensive. There is a temptation to forgo the expense and not use a regulator, but I must caution strongly against this. As table 1 above shows, a full cylinder of compressed gas will have an internal pressure of 2000+ PSIG. Normal atmospheric pressure is about 15 PSIA. If the cylinder valve was opened only slightly too far a great deal of very high pressure gas will flow through the delivery hose and metal wand and the potential for serious injury when it began to whip around would be very great. For your safety, get the necessary equipment. If you purchase your own regulator/gauge cluster and/or your own cylinder, there is necessity for periodic maintenance. Regulators and gauges need to be calibrated (using a water deadweight calibrator) and cylinders need to be hydrostatically tested, typically every ten years for both. Your gas supplier can provide you with more detailed information.

The only equipment that will come with your cylinder is the cylinder cap. "Don't leave home without it" and they mean it. All of the common cylinder sizes will use the CGA-580 (Compressed Gas Assembly) cylinder fitting. The downstream side of this fitting can be obtained with different threads, but a 1/4" NPT (National Pipe Thread) nipple is normally needed to mate with the regulator body. The nipple is really nothing more than just a short length of high pressure pipe. The CGA fittings come in a variety of metal compositions such as carbon steel, stainless steel and brass. The best choice is one which matches the composition of the regulator body. If the CGA fitting and regulator are to be used only with dry, non-oxygen gasses, in a dry environment then galvanic corrosion can be disregarded so the most inexpensive metal composition can be used even if it is not the same as the regulator. If it is to be used in a wet area, or with oxygen containing gasses then matching metal composition becomes very important.

When the tank is to be returned there must be some residual pressure still in the cylinder or the renter might have to pay a surcharge or lose their deposit. This is particularly true of purity assured gasses because the residual gas composition will be analyzed. This is done for the safety of all cylinder users.

The regulator/gauge cluster should be carefully removed using the same procedure that is described below to put it all together. Care should be taken not to damage the cylinder valve threads. Replace the cylinder cap and transport in the same manner as you brought it home.

### B.2.3 PUTTING IT ALL TOGETHER

If the fitting and regulator are bought separately then some 1/2" wide Teflon tape is recommended for assembly since it is a clean and inexpensive way of sealing pipe joints. Looking into the open end of nipple wrap the tape clockwise around the threaded end for 1.5 to 2 turns, working from the open end backwards. If you want to do a neat looking job, the tape may be slit lengthways to make it 1/4" wide, but this is not a requirement. A brass nipple may shrink somewhat during tightening and need a bit more tape than a harder metal like stainless steel would. The Teflon tape should only be used on the end of the nipple that attaches to the regulator body, NOT to any part of the cylinder end.

The regulator end has tapered threads and uses them directly for sealing. The cylinder end has straight threads and depends upon the precision mating of machined metal surfaces to seal. The cylinder end threads simply apply the clamping force.

Before attaching the CGA fitting to the cylinder the user should put on safety glasses and good hearing protection. The cylinder valve can then be cracked very slightly to blow out any dust or debris. After closing the valve, inspect the cylinder valve and nipple for any abrasions, nicks, gouges, embedded particles, etc., before attachment is made.

You will need two wrenches (not adjustable pliers) to equalize the torque, particularly on the cylinder valve where it should be minimized. Put one wrench on the fitting and the other wrench on the cylinder valve and make the join.

Once the regulator/gauge cluster has been mated to the cylinder, the delivery hose can now fitted to the regulator and the metal wand to the other end of the hose. The wand is nothing more than a short length of metal tubing at least six inches greater in length than the depth of the buckets to be filled. Copper water line works well.

When the joins have been made, a mixture of a short squirt of dish washing detergent and water can be used to check for leaks. Be certain the detergent does not contain ammonia. Pour some on each fitting working from the cylinder end outward, opening each valve and pressurizing as you go. Once the leak check is finished rinse off and wipe down all surfaces to minimize the chance of accidents in the future.

If the gas is not to be used at that time then the cylinder valve should be closed and all pressure should be drained to zero in the regulator and gauge. This should be done any time that the tank is not in actual use. If you have purchased your own cylinder then it is a good idea to also acquire one of the plastic valve plugs, similar to those seen with propane cylinders, in order to protect the cylinder valve threads and keep dust, debris and insects out of the valve.

WARNING: Care should be taken that the cylinder is used and stored in such a way as to minimize the risk of the tank falling over. With the regulator and gauge attached there is an increased likelihood

of damage occurring to the cylinder valve should the tank fall. Catastrophic failure of the cylinder valve will turn the tank into a high-energy, unguided rocket with the capability of doing great damage and/or serious injury.

### B.2.4 PUTTING IT INTO USE.

Having assembled and tested your gas system, you are now ready to begin the work of packaging your food. You'll need containers, and food grade plastic or Mylar bags that are a bit larger in internal volume than the container. Next is the dry food you intend to package and a pack of matches or a cigarette. You'll also need to wear the safety glasses and hearing protection you wore when you put the gas system together.

Take the containers you are going to use to store your food in, the bags that will line them and the food you are putting up and place them in some warm (not hot) area long enough for them all to equalize to that temperature. This will mean that the air contained inside them will also be at a warm temperature and make it more likely that it will stay on top when the cool gas from the nitrogen cylinder begins to flow in. The warm gas being on top will be the first to purge from the container, taking a good deal of the oxygen with it.

Line the interior of the container with a plastic bag or Mylar bag. Fill the container with the food product shaking to get it as full as possible. Don't forget to add your desiccant package if you're going to use one. You don't want any pockets left between the plastic bag and the container. Once you have gotten it full to just short of not being able to fully put on the lid, gather the top of the plastic bag together or heat seal the edges. If you have sealed it, cut a small corner off of the bag just large enough to allow a probe to enter.

At this point you can either simply flush the bag as described below or draw a vacuum on it first and then flush. If using a vacuum the suction probe should be kept at the top of the bag, just inside of the opening. The gas wand should be inserted to the bottom of the container, taking care not to poke any holes in the liner bag. Once both instruments are inserted, draw the vacuum. When it has reached a satisfactory level, shut of the suction, maintain the seal and turn on the gas.

Open the cylinder valve and set the regulator to a very slow gas flow and begin to fill the bag with gas. You want the container to fill slowly so you can minimize turbulence and mixing as much as you can. It'll take a little while to fill each container, a few minutes per bucket. Just as with dry ice, the idea here is for the cool gas to displace the warmer atmosphere from the container. The bag should puff just a bit. When I think it's full I'll hold a lit match just above the bag in the air that is escaping from it. If it snuffs right out then I let it run for about several minutes longer to flush out more of any remaining oxygen and remove the wand.

For the most efficient oxygen removal, repeat the suction/gas flushing procedure one more time. When satisfied, tie or heat seal the bag off and seal the bucket. Again, you want to have the bucket as full as possible so that there'll be only minimal air space. You should

monitor the containers for an hour or two after filling to check for any signs of bulging or other pressure build up as the cool gas inside gradually warms up and expands. A slight positive pressure is OK, but serious bulging needs some of the pressure released.

NOTE: Although the procedure for flushing a container with nitrogen is straightforward enough, actually getting a good purge of the container is not. Nitrogen flushing works best when the contents of the container are fairly coarse in size so that the gas flow around and through the food is free and unrestricted. Foods such as the larger sized grains (corn, wheat, barley, long grain rice, etc.), legumes and non-powdered dehydrated foods are best suited to this technique. Foods with small particle sizes such as flours, meals, and dry milks will flush with mediocre results.

Because of the difficulties in purging sufficient oxygen from a container to lengthen the shelf life of the food it contains many commercial suppliers have dropped this technique in favor of using oxygen absorbers. There is no reason that inert gas flushing and oxygen absorbers cannot be used together and one good reason that they should. If you are using five gallon plastic buckets as your storage containers, it has been observed that absorbers used in unlined pails can cause the air pressure inside the bucket to drop enough for the walls to buckle, possibly leading to a seal breach or a stack collapsing. For this reason, flushing with inert gas (nitrogen or CO2) might be a good idea, in order to purge as much oxygen as possible so that the pressure drop caused by the absorber removing the remaining oxygen will not cause the bucket to buckle. Liner bags can ameliorate the vacuum problems.

## C -- OXYGEN ABSORBERS

### C.1 WHAT IS AN OXYGEN ABSORBER?

If all of this messing about with gasses sounds like too much trouble, you can try using oxygen absorption packets. I don't know exactly when they first showed up on the market, but they are a relatively recent food storage tool. The packets absorb free oxygen from the air around them and chemically bind it by oxidizing finely divided iron into iron oxide. This removes it from being available for other purposes such as oxidative rancidity and respiration by insects, fungi or aerobic bacteria. The practical upshot of all this is that by removing the free oxygen from your storage containers, you can greatly extend the storage life of the foods in the containers.

The absorbers themselves have only a relatively short life span, roughly about six months from the time they were manufactured for the types that do not need external moisture.

Finding any information about these absorbers has been difficult, but, thanks to Al Durtschi, I was able to find a study of their effectiveness from Brigham Young University.

The study tested the absorption capacity of the Ageless Z300E packets made by Mitsubishi Gas-Chemical. It found they were even more effective than their rated absorption capacity of 300 milliliters of oxygen (O2 at sea level pressure). A single packet sealed into an empty

#10 can (80% of one gallon) reduced the oxygen in the canned air to less than 1/2%.

The following is the verbatim text of the conclusions section of the Brigham Young study. See V.B Pamphlets for the complete citation of this study.

Conclusions:

> "Oxygen absorbing packets are effective in reducing oxygen contents in sealed cans. The ageless Z300 packet has a greater than claimed capacity for absorbing oxygen. Packets abused by 4 hour-exposure-to-air still exceed claimed capacity. It may be economical to use smaller packets based on the dead air volume instead of can volume. Smaller packets would have less tolerance for abuse and personnel would need to be more diligent in protecting the packets."
>
> "The level of oxygen remaining in the presence of the absorber packets is sufficiently low to greatly retard development of rancidity. The biological consequences are not so easy to predict. Microorganisms range from aerobic to anaerobic, thus no unqualified statement can be made. The energy requirements of anaerobic bacteria are met by reactions between oxygen and more than one other molecule. This makes bacterial energy a higher order of reaction than rancidity. Thus, the rate of bacterial aerobic reaction would be more seriously retarded than rancidity. These matters are not of practical importance because the products to be canned should be too dry to support microbial growth. Insects are aerobic and would like-wise suffer retardation of activity. No comprehensive statement can be made about irreversible inactivation or death of insects. As long as the oxygen level remains low, insect activity will be lower by at least the square root of oxygen content. In a practical sense, these packets are effective in stopping insect activity. USDA does not recognize any method except disintegration as effective for completely killing insect eggs."

Use of Oxygen Absorbers in Dry Pack Canning

## C.2 WHERE CAN I FIND OXYGEN ABSORBERS?

Because they are a relatively new tool on the food preservation and storage market, oxygen absorbers have not yet achieved a widespread dissemination amongst the various storage food dealers and suppliers. They are available, but you may have to do a bit of searching to find them.

The following short list are the suppliers I've located, thus far, who sell them:

WALTON FEED
BEST PRICES STORABLE FOODS
DOUBLE SPRINGS HOMEBREW SUPPLY

NITRO-PAK PREPAREDNESS CENTER
SHERRY'S STOREHOUSE
CSIN
WWW.GLITCHPROOF.COM
COUNTRYSIDE GRANARY

In addition to the above suppliers it may be possible to acquire oxygen absorbers through a LDS family cannery if you have one locally available. *Please see section IV.A.2 for information on how to explore this possibility.*

C.3 HOW ARE OXYGEN ABSORBERS USED?

Even though the Z300E type will apparently absorb a great deal more than the 300 ml of O2 they are rated for, the following instructions for use are based on their listed rating. So, when using the Mitsubishi Ageless Z300E oxygen absorption packets, you should allow one packet for every quart and a half (1430 ml) of remaining air volume in your filled storage containers. The FreshPax D750 from the Multisorb Corporation work with just over 3 quarts (2860ml) of remaining air volume.

Now determining the volume of air remaining in a filled container is no easy thing. In the study, #10 cans filled with either elbow macaroni or powdered milk were used and their respective air volumes were determined. A can full of elbow macaroni was found to contain 22% remaining air volume and a can full of powdered milk was found to contain 10.5%. With these as guides, you should then be able to roughly figure the remaining air volume of the foods you have in your containers. You'll have to decide whether the food you are working is closer to the macaroni or the dry milk in its packing density. Obviously, this is a rather rule of thumb and this is why I kept my instructions to the listed ratings rather than on what they will apparently really do. The excess capacity will thus serve to cover the shortcomings of your reckonings. These absorption packets should be used only in dry foodstuffs and not with any product that will make them wet or oily.

Your absorbers begin their removal mission the second they come into contact with oxygen, whether it be in your storage container or in the open air waiting to be used. Try to arrange things in such a way as to have your container packed and ready to go before exposing the packets. Take out only those you are going to be able to use up in no more than about fifteen minutes or so else you are losing valuable absorption capacity. When you take them out of their package, spread them out on a tray so they do not contact each other. The oxidation reaction that absorbs the oxygen releases small amounts of heat. The warmer the packet becomes the faster the reaction occurs so you do not want the packets warming each other. Handle each one with tongs, gloved hands or by the edges of the envelope to keep body moisture and skin oils off. Seal the lid or seam of the container as soon as the packets have been inserted.

NOTES:

#1 -- Both Multisorb and Mitsubishi corporations advise that their oxygen absorbers should not be used in a high carbon dioxide environment. I haven't yet been able to determine if this is for

reasons of chemical interaction between the CO2 and the oxidation reaction occurring in the absorber.

#2 -- If you do choose to use oxygen absorbers in packing your food storage containers you should give some consideration to the container you're using. The absorber is going be removing the 20% of the atmosphere that oxygen constitutes. Since nothing is replacing it this will leave the interior of the storage container with a lower atmospheric pressure than the outside. If the container is sufficiently sturdy this pressure differential will be of little consequence. For containers with thinner walls or more flexible material the pressure drop could cause them partially collapse or buckle, particularly if other containers are stacked upon them. This could make them more likely to lose seal integrity. Metal cans and glass jars should have no problems. Plastic buckets made of HDPE are poor gas barriers and should have a liner bag of Mylar or other high gas barrier plastic when used with absorbers. Seal the absorbers inside of the liner bag so that the pressure drop with not stress the walls of the container. Other containers should probably be tested or first flushed with an inert gas (N2) before the absorber is sealed in.

#3 -- If the pack of absorbers you need to open contains more than you are going to use up in fifteen minutes or so, you should minimize exposure of the remaining packets. This can be done by heat sealing the bag they came in with an iron after expelling as much air as possible or better yet by vacuum sealing the bag. You can also put the remaining absorbers in as small a jar or metal can as they will fit in and closing with an air tight lid.

#4 -- If absorbers are sealed in a package with desiccants some thought should be given to just how low the relative humidity will be dropped. Silica gel will reduce humidity to approximately 40% which should not interfere with the absorbers oxidation reaction. Other desiccants, however, are capable of reducing relative humidity to very low levels. This might adversely affect your absorber's ability to carry out its mission by removing moisture from the absorber package that is necessary to sustain the oxidation reaction.

## D -- DESICCANTS

### D.1 WHAT IS A DESICCANT?

Moisture in inappropriate amounts and places is very damaging to the useful life of food. Because of this, much effort is put into reducing the water content of dry foods in order to prolong their shelf lives. Once it is reduced to the desired level the product can then be packaged for storage. Unfortunately, merely reducing moisture content is not always sufficient. Environmental conditions can play a role as well.

There are four mechanisms by which environmental conditions may cause a moisture problem in your food storage:

1. - The air trapped in the container with the food may have held sufficient humidity to raise the moisture content of the food to undesirable levels.

2. - Even if the water vapor content wasn't too high, a falling temperature level may cause the trapped humidity to reach its dew point causing water to be squeezed out of the air to condense on your food much the same way as dew forms on your lawn on cool mornings after a warm, humid night.

3. - The seal of the container may not be sufficiently tight enough to prevent moisture from leaking in.

4. - The packaging material itself may be porous to one degree or another to water vapor. All paper, wood and cardboard has this fault. Depending upon their particular physical properties many plastics do as well. Metal and glass containers have excellent barrier properties though their seals may not.

The solution for moisture problems is multi-faceted. First, make sure the product to be stored is at an appropriate water content for that particular foodstuff. Beans and grains store quite well at a 10% moisture level, but milk powders, dried eggs and dehydrated or freeze dried foods should be lower for best results.

Secondly, try to package your goods in a cool, dry atmosphere and do not allow extreme temperature swings in storage areas. Warm temperatures and high relative humidities when a container is sealed means the air trapped inside the container will have a high dew point. This will lead to condensation should storage temperatures fall below that dew point. An example of this would be a container sealed on a day that was 70 deg. F and 40% relative humidity. At that temperature the relative humidity would be quite reasonable for all but the most moisture sensitive food. However, should the temperature fall to 44 deg. F the capacity of the air to hold water vapor would have dropped to the point that it could not contain what was sealed in at 77 deg. and the excess would be squeezed out to condense on the food, i.e. - it will get wet. Possibly the food will be able to adsorb this moisture without harm and then again, it may not.

Thirdly, use appropriate packaging materials and make certain it is sealed correctly. If you are going to consume them in four to five years, storing grains, beans and peas in unlined HDPE buckets at normal humidities is fine. If you want to keep them at their best for ten years or more, the plastic the pail is made of is too porous to water vapor for best results and should have an interior liner of a material with better barrier properties. Dry milk powders should not be kept for more than a year in unlined HDPE, but can be kept for much longer in #10 metal cans, glass jars or Mylar bags. Naturally, even the most highly resistant packaging material is useless if its seal isn't good so be sure you use good technique when making closures.

Lastly, you may wish to consider using a desiccant if good humidity control at the time of packing is difficult or if you are not confident of the foods' moisture content or if the storage area is in a high humidity environment or if the packaging material does not have sufficiently high barrier properties.

A desiccant is a substance with very "hygroscopic" properties, meaning it will soak up water vapor from the air surrounding it. A number of different substances are capable of doing this, but only a relative few of them are of practical use and fewer still are going to

be readily available to the average person. Before elaborating on the different types that might be useful for our purposes it's necessary to explain how to choose a desiccant.

The U.S. military has done much of the best research on the use of desiccants in packaging and have largely set the standards by which they are judged. Each type of desiccant has temperature and humidity ranges where it performs best and particular physical and chemical characteristics that may need to be considered in relation to what you propose to do with them.

The standard most applicable for what can be done in home food storage defines a unit of desiccant as *the amount of desiccant that will adsorb at least 6 grams of water vapor at 40% relative humidity at 77 deg. F (25 deg. C).*

The following table gives the amount of desiccant necessary per square area for flexible containers such as Mylar bags or per volume of area for rigid containers such five gallon pails or #10 metal cans. The actual weight of a particular desiccant to use will depend upon the adsorbency per unit of desiccant mass.

| FLEXIBLE CONTAINERS (Mylar and other plastic bags) | | | RIGID CONTAINERS (Buckets, cans, jars, etc.) | | |
|---|---|---|---|---|---|
| | | Units of | Volume in: | | |
| Area sq ft | Area sq in | Desiccant Required | Gallons | Cu/FT | Cu/In |
| 0.1 | 30 | 1/6 | 1.1 | 0.14 | 237 |
| 0.3 | 45 | 1/3 | 2.1 | 0.28 | 476 |
| 0.6 | 90 | 1/2 | 3.2 | 0.42 | 714 |
| 1.3 | 180 | 1 | 6.2 | 0.83 | 1,428 |
| 1.9 | 270 | 2 | 12.5 | 1.67 | 2,856 |
| 2.5 | 360 | 3 | 18.7 | 2.50 | 4,284 |
| 3.1 | 450 | 4 | 25.0 | 3.33 | 5,712 |

[Table adapted from "Moisture In Packaging: Selecting the Right Desiccant" (c), Multisorb Corp. http://www.multisorb.com ]

In order to maximize surface area to obtain optimal adsorption, desiccants are manufactured in granular or powder forms. This presents a problem of keeping the desiccant, which may not be safe for direct contact with food, out of the product while still allowing sufficient air flow for it to carry out its task. Manufacturers call this "dusting" and deal with it by packaging the adsorbent in materials such as uncoated Tyvek, a spunbonded high-density polyethylene material produced by the Dupont corporation. Unfortunately, I have not yet been able to locate a retail source of uncoated Tyvek, just the coated variety such as is used in postal envelopes. Second best, and what I use, is one or more layers of coffee filter paper securely sealed over the mouth of the container holding the desiccant. I've also made "cartridges" of filter paper for use in narrow necked containers such as two-liter bottles. For this I used ordinary white glue, but getting a good seal all the way around without sealing too much surface area requires some care in execution.

For coarse granular materials tightly woven fabrics might serve the purpose providing the seams were adequate.

## D.2 TYPES OF DESICCANTS

### D.2.1 SILICA GEL

The most commonly known and used desiccant is silica gel which is a form of silica dioxide (SiO2), a naturally occurring mineral. It will work from below freezing to past the boiling point of water, but performs best at room temperatures (70-90 deg. F) and high humidity (60-90%). Its performance begins to drop off over 100 deg. F, but will continue to work until approximately 220 deg. F. It will drop the relative humidity in a container down to around 40% at any temperature in its range until it is saturated. Silica gel will absorb up to 40% of its weight in moisture. It is the only desiccant that is approved by the FDA for direct food use. It recharges easily and does not swell in size as it adsorbs moisture.

In the retail trade, the most commonly found form of silica gel is *indicating silica gel* which are small white crystals looking much like granulated sugar with small pink or blue colored crystals scattered throughout. This is ordinary silica gel with the colored specks being coated with cobalt chloride, a heavy metal salt. When the gel has absorbed approximately eight percent of its weight in water the colored crystals will turn from blue to pink making an easy visual indicator of whether the gel has become saturated with moisture. Because cobalt is a heavy metal, indicating silica gel is not food safe and should be kept from spilling into anything edible.

When saturated, silica gel can be dried out and used again. This is accomplished by heating the crystals in an oven at a temperature of no more than 300 deg. F for approximately three hours or until the crystals turn blue. Dehydrating the desiccant may also be accomplished by heating in a microwave oven. Using a 900 watt oven heat the crystals for three minute intervals until the color change occurs. The exact amount of time necessary will depend upon the oven wattage. Spreading the desiccant in a broad pan in a shallow layer will speed the process Heating to 325 deg. F or more, or by using a microwave oven over 900 watts can damage the gel.

Although I've never found anything that mentions this, apparently it is possible for silica gel to break down over time, or at least the colored crystals can. I had a five pound can stored in an outside shed here in Florida for several years before I opened it again to use some of it. Nearly all of the colored indicator specks had broken down and disappeared. I don't know if the gel itself was still good and with no way to reliably determine whether it was saturated or not, I discarded it. The can the gel was in was just cardboard and it gets very humid here in Florida so it really was very poorly stored. Under decent conditions it may not break down at all. (I've never heard of this occurring, anyway.)

### D.2.2 CLAY DESICCANT

Although not typically found for sale on the retail market, clay desiccant is fairly common in commercial and industrial use. The primary reason for this seems to be that it is inexpensive compared to any other form of desiccant.

The material is *Montmorillonite clay*, composed primarily of magnesium aluminum silicate, a naturally occurring mineral. After mining it is purified, reduced to granules and subjected to a controlled dehydration process to increase its sorbent porosity. It recharges easily and does not swell as it adsorbs water vapor. It works well at low and room temperatures, but has a rather low ceiling temperature. At 120 deg. F it will begin to desorb or shed the moisture it has adsorbed. This is an important consideration for storage in hot areas.

Subject to a degree of variability for being a natural material, clay desiccant will adsorb approximately 25% of its weight in water vapor at 77 deg. F and 40% relative humidity.

### D.2.3 CALCIUM OXIDE

Also known as "quicklime" or "unslaked lime", calcium oxide is a slow, but strong adsorbent. It is efficient at low humidities and can drop moisture vapor to below 10% relative humidity. Qucklime is *caustic* and must be carefully handled, particularly with regards to dust inhalation and exposure to skin and eyes. It expands as it soaks up water vapor and this must be taken into account when packaging it. It will adsorb up to about 28% of its weight in moisture, but does it slowly over a period of several days rather than a matter of hours like other desiccants. It is most effective when used in high humidity environment where a very low level is desired. It will release a great deal of heat if exposed to direct (liquid) moisture or extreme humidities.

It can be recharged, but I do not have any details on how to go about this other than roasting at fire temperatures.

For expedient use, quicklime can be manufactured from clean, pure lime stone or pickling lime available in the canning sections of many grocery and hardware stores.

### D.2.4 CALCIUM SULFATE

Also known as the mineral gypsum and commercially as Drierite, calcium sulfate is another naturally occurring mineral. It is produced by the controlled dehydration of gypsum ($CaSO_4$). It is chemically stable and does not readily release its adsorbed moisture. It has a low adsorbency capacity, only approximately 10% of it weight. It can be regenerated, but apparently not easily so.

For expedient use, gypsum is commonly used in household drywall and Kearny mentions using this source in his Nuclear War Survival Skills.

### D.2.5 OTHER DESICCANTS

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From: Pyotr Filipivich pyotr@coho.halcyon.com

Simple trick is to dry a piece of wood in the oven and once it is bone dry (more than usual) then put it in your container and seal it. The wood will suck up any available moisture.

Editors note: Wood can soak up to 14% of its weight in moisture, depending on species. Woods with coarse, open grains work the best. I'm not aware at what temperature it will begin to "desorb" or shed its stored water and it might be fairly low. Some empirical experimentation would be in order before relying heavily on it.

## D.3 WHERE DO I FIND DESICCANTS?

I buy indicating silica gel at Wal-Mart in their dry flower section where it is sold in one and five pound cans for flower drying. I've seen it sold the same way in crafts stores and other department type stores that carry flower-arranging supplies. You can also buy it from many other businesses already prepackaged in one form or another to be used as an adsorbent. All of the desiccant that I've found packaged this way has been rather expensive (to me) so shop carefully.

Businesses carrying packaging supplies sometimes also sell desiccants. Some businesses commonly receive packets or bags of desiccants packaged along with the products they receive. I've seen Montmorillonite clay in bags as large as a pound shipped with pianos coming in from Japan. Small packets of silica gel seem to be packed in nearly everything. Naturally, any salvaged or recycled desiccant should be of a type appropriate for use with the product you want to package.

It is possible to make your own desiccants using gypsum from drywall and maybe Plaster of Paris. Calcium oxide can also be produced from limestone (calcium carbonate) or slaked or pickling lime (calcium hydroxide) by roasting to drive off the adsorbed water and carbon dioxide. I don't have any clear instructions, as of yet, on how to go about this. Please do keep in mind that calcium oxide (quicklime) is caustic in nature and is hazardous if handled incorrectly.

## D.4 HOW DO I USE DESICCANTS?

Ideally, the dry foodstuffs you have on hand will have no more than a 10% moisture content. If they do not then you will need to reduce moisture to a level appropriate for the kind of food you are storing.

One of the following methods might be of use in lowering moisture content. The least involved is to wait until the driest time of year for your location making sure there is plenty of free air circulation around the food product. If this doesn't suit, then turn your air conditioning on a little high. Bring in your buckets, lids, and the storage food. Let everything sit in a well-ventilated place where it's going to get plenty of cool, dry air from the A/C (avoid anywhere near the kitchen or bathroom areas, as they put out a lot of moisture). Stir the food frequently to maximize moisture loss. About three days of cool, constant air flow and low humidity ought to dry things out a bit. Due to its highly odor absorptive nature, I would not do this with any

dried milk products or other powdered foods, flours or meals . This method works best with coarse particles such as grain, legumes and dried foods.

Warm, dry air can also be used to accomplish this and works well if you have large quantities of grains and legumes. It is very similar to what is used on farms for drying harvested grain. You'll need a source of forced, warm, *not hot*, air. Place the grain in a drum or barrel and blow the heat from the bottom so that the warm and the moisture it will carry can exit from the top. It's important to not let the bottom product get too hot. You should also monitor the top, center of the drum to be certain that the product there is not getting too damp from the moisture escaping from other areas. Stirring occasionally may be necessary. I've seen this done with an old, drum style vacuum cleaner that put off fairly warm exhaust air and it worked pretty well. Do be sure to clean the vacuum so you don't blow the grain full of dust.

If the above methods won't do or you have powdery foods to dry, you can place a large quantity of desiccant in a storage container. Fill the remaining space with your food product and seal on the lid. After about a week, unseal and check the desiccant. If it's saturated, change it out with dry desiccant and reseal. Continue to do this until the contents are sufficiently dry. Calcium oxide will work particularly well for this. If it doesn't become saturated the first time, change it anyway before sealing the bucket permanently. You'd hate to find later it saturated in storage.

If your food products are sufficiently dry you can pack them in storage containers using the packaging method of your choice and have a reasonable expectation of your food staying in good condition. Whether you will need to use a desiccant will be dependent upon the conditions discussed above.

I use indicating silica gel for practically everything. My usual procedure is to save or scrounge clear plastic pill bottles, such as 500ct aspirin bottles or small plastic jars, such as the smaller sizes of peanut butter comes in. Fill the bottle with the desiccant (remember to dry the gel first) and then use a double thickness of coffee filter paper carefully and securely tied around the neck of the bottle to keep any of it from leaking out. The paper is very permeable to moisture so the gel can do its adsorbing, but it's tight enough not to let the crystals out. This way moisture can be safely adsorbed. It won't dry out a lot of moisture -- you still need to take steps to get everything as dry as possible before you pack it -- but it will take care of what little is left.

The above method will also work for the other desiccants, subject to whatever precautions the individual type may have.

IMPORTANT NOTE: The indicating form of silica gel (has small blue or pink specks in it) is not edible so you want to use care when putting together your desiccant package to insure that is does not spill into your food.

## E -- DIATOMACEOUS EARTH

### E.1 WHAT IS DIATOMACEOUS EARTH?

Diatomaceous earth is a naturally occurring substance comprised of the fossilized remains of marine diatoms. These diatoms are microscopic in size and are covered in sharp spines that make them dangerous to exoskeletal insects, but not to animals with internal skeletons. The spines of the diatom skeletons pierce the soft body tissues of insects between their hard exoskeletal plates and it is through these numerous microscopic wounds that the insect loses bodily moisture to the point of desiccating and dying. Creatures with internal skeletons such as humans, cattle and pets have means of resisting such damage and are not harmed. Thus, it is possible to mix a small amount of DE into your stored grains and beans to control insects without having to remove the dust again before you consume them.

## E.2 WHERE DO I FIND D.E. AND WHAT TYPE SHOULD I BUY?

IMPORTANT NOTE: There are actually two kinds of diatomaceous earth to be found on the market and only one of them is suitable for use as an insecticide to use in your stored grains. The kind that you DO NOT WANT FOR FOOD USE is the type sold by swimming pool suppliers as a filtering agent. It has been subjected to a heat treatment that dramatically increases it's silicate content and makes it unsuitable for use with your foodstuffs. The type that you want is sold by a number of suppliers as a garden insecticide. Many organic garden suppliers will carry it. Read the label carefully to be certain no deleterious substances such as chemical pesticides have been added. An appendix with the names and addresses of some DE suppliers may be found in the food and equipment suppliers section.

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From: higgins10@aol.com (Higgins10)
Originally posted in: rec.gardens

Good afternoon all. Diatomaceous earth is approved by the USDA as an animal feed additive, however I have found out that there are vast differences between various forms of diatomaceous earth. Some DE products may not be effective in controlling insects, while others may be harmful to humans and pets. The most important differences between individual forms of DE is the shape of the diatom, content of Crystalline Silica, and the purity of the Silica Dioxide. The World Health Organization cautions that DE with a crystalline silica content of three percent or higher is dangerous to humans, (and probably pets and birds as well). Diatomaceous Earth used in swimming pool filters has close to a 60% crystalline silica content. I know of a product called Organic Solutions (insecticide) which is approved by both the EPA and USDA and has a crystalline silica content ranging between 0.36% to 1.12% according to its labels etc. It is classified as Amorphous Fresh Water Diatomaceous Earth (whatever that means). However, all literature I have read assures it is safe for both humans and animals and seems to be very effective at killing insects. I stumbled across all this info. while shopping in the mall. If you're interested in reading it too, go to the Organic Solutions website at http://www.BuyOrgs.com. Hope this helps answer the question and always use environmentally safe products!
Higgins10

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From:  kahless@ns.waymark.net
Date: Sat Aug 24 14:08:48 1996
To: Dunross (A.T. Hagan) Private e-mail

[previous text deleted]

I have always purchased DE at the local feed store.  It's cheaper there than at the garden and hardware stores.  The feed store I buy at has DE available in bulk, but they'll package up a smaller amount if that's what you want.  My package in the garage doesn't have a brand name but says "Nitron Industries" at the bottom.  The label recommends 7 pounds of DE for each ton of grain.  Ha! As if I had "tons" of grain in storage 8-D

I've been using DE for grain storage for about 15 years now but flea control only for the past 6 years.  The only fleas we've seen in that period of time is the ones that hitch a ride in with friends pets. A very light dusting afterward takes care of that problem.  Miracle stuff as far as I'm concerned since we'd had an awful time with fleas before we started using DE.  Much much much cheaper and as far as I'm concerned the advantages FAR outweigh the risks.

Sam
(hope that was helpful)

### E.3  HOW DO I USE D.E. IN FOOD STORAGE?

To use, you should mix thoroughly one cup of DE to every forty pounds of grain, grain products or legumes.  You need to make certain that every kernel is coated so it is better to do the mixing in small batches where you can insure more even coating.

WARNING: DE is a very powdery kind of dust, so you need to take steps to keep it out of your lungs and eyes. Even whole wheat flour dust can cause lung irritation if you breath enough of it.

DE does not kill the insect eggs or pupae, but it will kill adults and larvae and any eggs or pupae that hatch into adults will die after coming into contact with it.

## ==========
## -- V --
## SHELF LIVES
## ==========

"How long will this keep?"  This is the defining question of food storage.  Everything you will read in this work evolves from this central question.  The length of time a particular food will remain palatable and nutritious in storage determines its usefulness for our purposes.  The fact of the matter is that there are few hard and clear answers.  As a result it is not uncommon to find two or more sources who purport to know, but that give conflicting data.  The following will hopefully cut through some of the fog.

A. "BEST USED", "USE BY" AND OTHER FOOD PRODUCT DATES

Although there are some twenty States in the U.S. that have food product dating laws the Federal government has little regulation concerning food product dating except for infant formulas and some baby foods. It does, however, require that if a manufacturer puts a calendar date on a food product it must also put wording to the effect of "use by" or "best before" next to it to explain what the date means. This is called "open dating" which is to say that it is a plain, easy to read calendar date rather than "closed or coded dating" that must be deciphered. Another date also commonly seen is the "sell by" date. While not as useful for food storage, it does have importance for day-to-day fresh food purchases.

Because the Federal government has so few food product dating standards manufacturers use their own to determine acceptable shelf lives. For the most part, they are based upon changes in texture, appearance, taste and cooking qualities. When a food item begins to exhibit signs of aging that would make it unappealing to customers then it is considered to be at the end of its marketable shelf life. Look for statements such as "use by", "best if used by", "best if used before" or similar wording to find this date. For shelf stable and frozen products it must include both the month, day and year. These dates are useful for determining how long a product can be retained in the storage program before it should be rotated out. When a food begins to undergo taste and appearance degradation the nutrient content will have begun to seriously fade and the time will have come to use it up so it can be replaced with fresh stock. If the product was properly preserved and not subjected to extreme storage conditions it is not unsafe to use after this date. If there is nothing to replace it with it may be kept, but its palatability and nutritive content will just continue to degrade.

Fresh food items such as meat, milk and eggs use a "sell by" date which simply means that the item should not be purchased beyond that date. Products using this date type are only required to use the day and month. Provided that it was properly transported and stored, an item kept past this date is not unsafe to use, but will begin to exhibit signs of aging that will make it unappealing and should be frozen or consumed shortly thereafter.

NOTE: The shelf life of any food, whether indicated with a "use by" or "sell by" date or found on some chart, is predicated upon assumed storage conditions. If the actual storage conditions are different from the assumed storage conditions then the shelf life will naturally vary. As is explained in *Section I: Time, Temperature, Moisture, Oxygen and Light*, environmental storage conditions have a major impact on the length of time any foodstuff will remain palatable, nutritious and even whether it will remain safe.

As a general rule, when a shelf life is given, it is for conditions of 70 deg. F in a dark, dry location unless stated otherwise. Be sure to read the fine print on any shelf life chart you may come across to see what its values are predicated upon. There are some floating around giving shelf lives of foods in storage temperatures as low as 40 deg. F. At that temperature you would expect to keep your fresh butter, eggs and

milk, but very few have the ability to keep any significant amount of canned goods in so cool a storage area.

Regardless of what the date or chart may indicate, if storage conditions have been very poor then a food will become non-nutritious, unpalatable, perhaps even unsafe to eat even if its listed time is not yet up. An example of this would be keeping egg salad at room temperature for several hours at a picnic. The eggs may have been laid yesterday, but you are taking your chances if you eat it. Never put blind faith in any date. Always keep in mind that they are predicated on unspoken assumptions. IF THE CONTAINER IS BULGING, MOLDED, FOUL SMELLING OR SPEWS LIQUID WHEN OPENED, THROW IT OUT! But throw it out safely so that children and animals cannot get into it.

*Please see Section III: Spoilage for further information*

B. CLOSED DATING CODES USED BY SOME FOOD MANUFACTURERS.

In spite of the fact that increasing numbers of food processing companies are moving to open dating it is not yet universal. For those products that do not come with a plain "best used by" date it is still possible, albeit with much more difficulty, to determine the rotation period for that specific product.

For a processor to move their product in interstate commerce it must exhibit a packing code. This allows them to easily track their product for purposes of stock rotation and in the event of a recall. These packing codes are usually a series of letters and numbers that indicate dates, times, and sometimes places of manufacture. These dates are not "use by" dates, but the time the container was actually filled. As they are not really intended for general public knowledge these codes are frequently unique to a particular processor and are not commonly published by them.

It is possible to get the keys to these codes by contacting the processor and asking how to decipher the dating code for specific product lines. Over time, readers have been doing this and the code keys below are the ones that have been sent to me. Obviously, they are only a few of the many, many products that use closed dating and I hope that future readers will continue to send these codes in as they are gleaned from the processors.

Frankly, when it comes to the potential dozens of products that would require deciphering their packing codes the entire process is a major nuisance. While it is better to have an encoded date than not to have one at all, it would be far better if processors would just use clear open dating and (best used by) so we wouldn't have to carry a book of code keys like covert agents every time we go to the grocery.

Before I list specific manufacturers there is one fairly widely used code key that may be useful. Some processors use a system where all the days of the year are listed 1-365 (366 for leap year) as the first three digits in the code. This number is then followed by a single letter such as "B" and then by a single digit that represents the year.

Some examples of this might be:

| Packing code | Date packed |
|---|---|
| 045B97 | February 14, 1997 |
| 101H98 | May 1, 1998 |
| 134K96 | July 4, 1996 |
| 252U98 | October 31, 1998 |

There may be other widely used coding systems yet to be discovered and as they become available I will include them in this work.

SPECIFIC PRODUCT LINES:

IMPORTANT NOTE: I have not personally verified all of these code keys. Also, closed date coding schemes may change over time. For this reason, the code keys given below may not be correct. Be sure to check a number of containers in a product line to verify that a particular code key will work with the product line you are interested in.

ARMOUR STAR CANNED MEAT PRODUCTS

Vienna Sausage, Stew, Chili, Deviled Ham, Potted Meat, Slice Dried Beef, Soups, etc. but does NOT include Armour Star Roast Beef or Corned Beef.

The code is on the bottom of the container. The first letter is the month of production; A=January, B=February, C=March and so on. The following two numbers represent the day of the month it was processed and the third number indicates the year.

Example: A code of B148C23 would be B=Feb, 14 = the fourteenth day, 8=1998. B148C23=February 14, 1998 and the last three characters would be plant or processing line locations.

Armour Star Microwaveable Meals have a two line production code on the container lid. The second line is the is date and uses the same code as above.

BERTOLLI OLIVE OIL

Packed two years prior to the use by date on the bottle or can.

BUSH BROTHERS & CO.

Baked beans, chili, etc.

A five digit code on the bottom of the can. The first digit is the month, the next two digits is the day of the month, the next number is the year and the last digit is ignored.

Example: A code of 50173 deciphers to be:

5  = the fifth month or May
01 = the first day of May
7  = 1997
3  = last number is discarded.

Thus 50173 is May 1st, 1997.

CAMPBELL SOUPS:

Best by date on cans.  Filled exactly two years prior to that date.

DEL MONTE

Canned fruits, vegetables, etc.  I'm not sure if it applies to *all* product lines.

A five character packing code, usually on the bottom.  The first character is a digit representing the year.  The next three characters are digits representing the day of the year the product was packed.  The last character is a letter and may be ignored.

Example:  A packing code of  8045B deciphers to be:

8   = 1998
045 = The 45th day of the year or February 14th.
B   = A plant code.

Thus 8045B is February 14th, 1998.

GENERAL MILLS:

The manufacturing date is coded to their fiscal year that begins on June 1st and ends on May 31st.

Interpret the code as follows:

The first character of the code is a letter and represents the month the product was made.

The second character in the code is a number which represents the year the product was made.

The following two characters are numbers that represent the day of the month the product was made.

The remaining characters following identify plant location and shift information.

Example:  A packing code of  E731B would translate as follows:

E  = October
7  = 1997
31 = 31st day of the month
B  = A plant location

The following is their 12 month cycle. The letter "I" is not used because it can be confused with the number "1".

| | | |
|---|---|---|
| A = June | E = October | J = February |
| B = July | F = November | K = March |
| C = August | G = December | L = April |
| D = September | H = January | M = May |

HANOVER FOODS CORP.

Small whole potatoes, green beans, corn, etc.

A five digit code on the bottom of the can. Omit the first digit. The next digit is the year. The remaining three digits are the day of the year the product was packed.

Example: A code of 28304 deciphers to be:

2 - discard this number
8 = 1998
304 = the 304th day of the year or October 31st

Thus 28304 is October 31st, 1998

HEALTHY CHOICE:

First character is a number, second is a letter with the remaining characters being a lot ID. The number is the year it was packed with the letter being the month, October = A, November = B, December = C, January = D, and so on through the year. The recommended shelf life is 2 years.

HORMEL PRODUCTS

Their packing code is a letter followed by five numbers. The letter is their plant location and the numbers are the dating code in a MM-DD-Y format.

Example: A code of G07048 decodes to mean:

G = plant location
07 = July
04 = The fourth day of the month
8 = 1998

The can was packed July 4, 1998 at plant location G.

JELL-O BRAND PUDDINGS & GELATINS

The first four digits are the date coding. The first digit is the year and the following three digits is the day of the year.

Example: A packing code of 804522 10:38 deciphers as:

8 = 1998
045 = the 45th day of the year or February 14th
22 = discard the last two digits.
10:38 = the time it was packed.

Thus 804522 10:38 means that box of pudding mix was packed on February 14th, 1998 at 10:38 a.m.

McCORMICK HERBS & SPICES:
(See also http://www.mccormick.com/info/oftenasked.html )

There should be a four digit number of the bottom of the spice package or extract bottle. On foil packages, it will be around the outside edge. This code is more complicated than other manufacturers so read closely.

Example: Using a number 3604 as the packing code:

To derive the year, take the first number and add 5 (3 + 5 = 8) so 1998 is the year of manufacture.

To derive the month and day, divide the last three digits by 50 (604 ÷ 50 = 6 with 4 remaining). The six indicates the last whole or complete month before the month of production, January, February, March, April, May, and then June. The next month, July, is the production month. The 4 remaining is the day it was produced.

Therefore a packing code of 3604 means that product was packed July 4, 1998.

While not as precise, you can save considerable time by just finding the year. The last three digits representing the day and month will increase as the year grows.

PROGRESSO FOODS

Canned soups, beans, etc.

Two lines of code on top of the can. The top line, the first two characters are the date portion. The first character is a letter indicating the month and the second character is a digit indicating the year.

Example: A packing code of L7N18 1211 (this is the first line) would be:

L = 12th month or December
7 = 1997
N18 = ignored
1211= ignored.

Thus a packing code of L7N18 1211 indicates the can was packed in December of 1997.

C. SHELF LIVES OF SOME COMMON STORAGE FOODS.

The chart given below has been adapted from a number of different shelf-life charts published by the cooperative extension services of several states. It presupposes no special packagings other than the way the food comes from the store. The general assumption is that when a given foods' taste, appearance or texture begin to take on noticeable changes it has reached the end of its best marketable shelf life and should be rotated out. This is not to say the food is no longer edible, but it is losing nutritional content at the same time so no purpose is served by keeping it for longer than is necessary to replace it with fresher stock. For what it's worth, I'm not fully in agreement with it myself, but it's a good working hypothesis and I modify it by my personal experience which may vary from yours. If it is a dry food then only dry utensils should be used to remove it from its container. The less light, moisture, heat and oxygen it comes into contact with, the longer the food will keep.

All of the below are for new, unopened containers.

| FOOD | RECOMMENDED STORAGE TIME AT 70 deg. F. | STORAGE TIPS Keep the product: |
|---|---|---|
| Baking powder | Till can date | Sealed & bone dry |
| Baking soda | 2 years | Sealed & bone dry |
| Biscuit, brownie, muffin mix | 9 months | Sealed, cool and dry |
| Bouillon, cubes or granules | 2 years | Sealed, cool and dry |
| Cake mixes, regular | 9 months | Sealed, cool and dry |
| angel food | 1 year | Sealed, cool and dry |
| Canned food, metal can, non-acidic | 2 years | Cool |
| metal can, acidic | 12-18 months | Cool |
| glass jars | 2-3 years | Dark and cool |
| Chocolate, semi-sweet or unsweetened | 18 months | Cool and dark |
| Chocolate syrup | 2 years | Cool & tightly sealed |
| Cocoa, powder or mixes | 8 months | Sealed and cool |
| Coffee, regular | 2 years | Cool, dry and sealed |
| instant | 1-2 years | Sealed |
| Coffee creamers, powdered | 9 months | Sealed and cool |
| Cornmeal | 1 year | Guard against weevils |
| Cornstarch | 18 months | Dry |
| Crackers | 3 months | Dry |
| Flour, white | 8-12 months | Guard against weevils |
| whole wheat | 6-8 months | Cool and weevil proof |
| Frostings, canned | 3 months | Cool |
| mix | 8 months | Dry and cool |
| Fruits, dried | 6-12 months | Cool & sealed |
| Gelatin, all types | 18 months | Protect from moisture |
| Grains, whole | 2 years | Dry and weevil proof |
| Hominy & hominy grits | 1 year | Guard against weevils |
| Honey | 1 year | Sealed |
| Jellies, jams, preserves | 1 year | Refrigerate after use |
| Molasses & syrups | 1 year | Sealed |
| Mayonnaise | 6 months | Refrigerate after use |
| Milk, condensed or | | |

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      evaporated.............1 year..........Turn over every 2 mos
      Non-fat dry............6 months.........Bone dry and cool
Nuts, vacuum canned..........1 year..........Cool and dark
      other packaging........3 months.........Cool and dark
      in shell...............4 months.........Cool, dry and dark
Pancake mix..................6-9 months........Dry and weevil proof
Pastas
 (macaroni, noodles, etc).....2 years.........Guard against weevils
Peanut butter................6-9 months........Sealed, cool, dark
Peas and beans, dry
 (not soybeans)..............2 years.........Dry and weevil proof
Potatoes, instant............6-12 months.......Dry and weevil proof
Pudding mixes................1 year..........Cool and very dry
Rice, white..................2+ years.........Guard against weevils
     brown...................3-6 months........Cool and weevil proof
     flavored or herb........6 months.........Sealed & weevil proof
Salad dressings..............10-12 months.......Refrigerate after use
Salad oils...................6 months.........Sealed, dark and cool
Sauce and gravy mixes........6-12 months.......Cool and dry
Shortening, solid............1 year..........Dark
Soup mixes...................1 year..........Cool and dry
Sugar, brown.................6 months.........Airtight container
       confectioners........18 months.........Dry and sealed
       granulated...........2+years..........Dry
Syrups (corn syrup based)....8-12 months.......Sealed and cool
Tea, bags....................18 months.........Sealed and dry
     instant.................3 years..........Sealed
     loose...................2 years..........Sealed and dry
Vegetables, dried............1 year..........Cool and sealed
Vinegar......................2+ years.........Sealed
Yeast (dry)..............Pkg expiration date....Cool and dry
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## -- VI --
## RESOURCES

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[This FAQ does not tell me what I need to know!]

Please put the question to the *rec.food.preserving*, *rec.food.cooking*,*misc.survivalism*, *alt.survival* or *misc.rural* Usenet newsgroups. You could even resort to the tried and true method, a book.

The following is a list of books that I have found to have useful information. It is by no means an exhaustive list on the subject. If you have books you would like to suggest, please feel free to e-mail me with the particulars. If you can please include the same kind of information about the book in question as you see below, particularly the ISBN #, if it has one.

A. BOOKS:

A YEAR'S SUPPLY; Barry G. & Lynette B. Crockett; 1988; ISBN# 0-915131-88-9; Available form the author at P.O. Box 1601, Orem, Utah 84057 and available in some stores. Publisher's Press.

BOOK OF TOFU, THE; William Shurtleff & Akiko Aoyagi; 1975; ISBN#0-345-35181-9; Ballantine Books.

BUILD YOUR ARK! Book 1: Food Self-Sufficiency; Geri Guidetti; 1996; ISBN# 0-938928-01-5; Published by the author; The Ark Institute, P.O. Box 142, Oxford, Ohio 45056; http://www.arkinstitute.com; E-mail to arkinst@concentric.net

COOKIN' WITH POWDERED MILK and COOKIN' WITH POWDERED EGGS; Peggy Layton; Both 1994; No ISBN; Available from the author P.O. Box 44, Manti, Utah, 84682.

COOKIN' WITH HOME STORAGE; Vicki Tate; 1993; ISBN# none; Published by the author; Address: 302 East 200 North, Manti, Utah, 84642; Tel # (801) 835-8283

COUNTRY BEANS; Rita Bingham; 1996; ISBN 1-882314-10-7; Published by Natural Meals In Minutes 30500 SE Jackson Rd, Gresham, OR 97080.

CREATING THE COMPLETE FOOD STORAGE PROGRAM; Skipper Clark; 1996; No ISBN; Available from the author, Sierra Sun Publishing, P.O. Box 6209, Oroville, CA 95966

HOME FOOD SYSTEMS; Edited by Roger B. Yepsen, Jr.; 1981; ISBN# 0-87857-325-9; Rodale Press.

HOW TO DEVELOP A LOW-COST FAMILY FOOD-STORAGE SYSTEM; Anita Evangelista; 1995; ISBN 1-55950-130-8; Loompanics Unlimited.

HOW TO DRY FOODS; Deanna DeLong; 1992; ISBN 1-55788-050-6; HP Books

KEEPING FOOD FRESH; Janet Bailey; 1985; ISBN# 0-385-27675-3; Doubleday & Co.

KEEPING THE HARVEST; Chioffi and Mead; 1991; ISBN# 0-88266-650-9; Storey Communications.

LIVING WELL ON WHEAT; Geri Guidetti; 1997; ISBN 0-938928-02-3; Published by the author; The Ark Institute, P.O. Box 142, Oxford, Ohio 45056; http://www.arkinstitute.com ; E-mail arkinst@concentric.net

MAKING THE BEST OF BASICS - FAMILY PREPAREDNESS HANDBOOK; James T. Stevens; 1996; ISBN #1-882723-25-2; Gold Leaf Press or from the author: 15123 Little Wren Lane, San Antonio, TX 78255; E-mail jstevens@iamerica.net

MARLENE'S MAGIC WITH FOOD STORAGE; Marlene Petersen; 1991; No ISBN; Published by the author; Marlene's Magic, 4958 Alpine Circle Highland, Utah 84003

NUTRIENT CONTENT OF THE U.S. FOOD SUPPLY, 1909-1988; 1992; Nutrient Education Division; Human Nutrition Information Service of the USDA.

NUTRITIVE VALUE OF AMERICAN FOODS; Catherine S. Adams; 1975; No ISBN; USDA Handbook No. 456

PERMACULTURE BOOK OF FERMENT & HUMAN NUTRITION, THE; Bill Mollison;

1993;  ISBN 0-908228-06-6;  Tagari Publications

PUTTING FOOD BY;  Greene, Hertzberg and Vaughn; 1982 (14th edition); ISBN# 0-525-93342-5; Penguin Group.

RECOMMENDED DIETARY ALLOWANCES (The RDA Book);  National Research Council;  1989(10th edition);  ISBN 0-309-046335 (paper); National Academy Press

ROOT CELLARING (1994);  Mike and Nancy Bubel;  ISBN 0-88266-703-3.

TOFU & SOYFOODS COOKERY;  Peter Golbitz;  1998;  ISBN 1-57067-050-1; Book Publishing Company;  P.O. Box 99, Summertown, TN   38483

WHOLE GRAINS;  Sara Pitzer;  1981; ISBN #0-88266-251-1; Garden Way Books

B.  PAMPHLETS:

Consumer Information Center, Department EE, Pueblo CO 81009.  Ask for the Consumer Mailing List Catalog.  You can order those nifty USDA pamphlets from this catalog.

Check your extension service office for pamphlets, which can usually be bought for a dollar or so.  Especially important for high altitude canning, getting recipes specific for locale, even information on U-Pick sites and local farmers' markets.

Controlling Indianmeal Moths in Stored Shelled Corn and Soybeans; Phil Harein and Bh. Subramanyam; FS-0996-A-GO Revised 1990 Minnesota Extension Service, University of Minnesota

FOOD STOCKPILING FOR EMERGENCY SHELTERS;  Food and Materials Division, Commodity Stabilization Service, USDA, April 1961]

Food Storage In The Home FN502;  Utah State University Cooperative Extension Service Bulletin

Frequently Asked Food Questions FN 250;  1993 Utah State University Cooperative Extension Service Bulletin

Molds And Mycotoxins In Feeds; C.M. Christensen, C.J. Mirocha, R.A. Meronuck; FO-3538-C-GO 1988; Minnesota Extension Service, University of Minnesota

Molds In Grain Storage; Richard A. Meronuck;  FO-0564-C-GO; Revised 1987;  Minnesota Extension Service, University of Minnesota

Nonfat Dry Milk FN142;  Utah State University Cooperative Extension Service Bulletin

Use of Oxygen Absorbers in Dry Pack Canning; Albert E. Purcell, Theodore C. Barber, John Hal Johnson;  Benson Quality Assurance Laboratory Department of Food Science, Brigham Young University

C.  MAGAZINES:

American Survival Guide
P.O. Box 68033
Anaheim, CA  92817-0833
(714) 693-1866

Backwoods Home Magazine.  Dave Duffy, publisher.
P.O. Box 712
Gold Beach, OR  97444
(541) 247-8900
http://www.backwoodshome.com

Countryside & Small Stock Journal
N2601 Winter Sports Rd,
Withee, Wisconsin 54498
(800) 551-5691

Mother Earth News
P.O. Box 56302
Boulder, CO  80322-6302
(303) 678-0439

D.  PHONE:  (non-modem)

Your local cooperative extension service--check your local university directory, especially if its a Land Grant College; look under Government Services, under Dept. of Agriculture. Master Preservers--similar to Master Gardeners or Master Composters.

E.  ELECTRONIC:

E.1  INFORMATION SOURCES

ftp://ftp.ucdavis.edu/pub/extension/4h-youth/fp001.zip-fp008.zip

Files are compressed, written in Word Perfect 5.1 or Post Script format. Files are eight lessons in food preservation.

ftp://ftp.michvhf.com/pub/rec.food.baking/FAQ

The FAQ for the *rec.food.baking* news group.  Good stuff.

http://waltonfeed.com/self/default.htm

The Walton Feed information area on food production, preservation, and storage, water storage and purification, nutrition, planning, culture and a great deal of other useful information.  One area also has the labels showing contents, nutritional breakdowns and other information of most of the products produced and/or sold by Walton Feed. Also listed are head gas analyses of their packaged products. He has a good section on do it yourself food storage packaging as well.

http://www.idos.com

This is the home of The International Dutch Oven Society.  There's more here about how to use Dutch ovens to cook more foods than you

ever thought about. Also a lot of good links, including Macscouter, a Boy Scout site with a lot of open fire cooking information.

http://www.nyx.net/~dgreenw/sourdoughfaqs.html

A truly vast collection of information, recipes and tips on sourdough breads of every sort and some really interesting links. The *rec.food.sourdough FAQs* may be found here as well.

http://sunsite.unc.edu/hermed

A collection of FAQs and other assorted information and pictures of culinary and medicinal herbs.

http://www.geocities.com/Heartland/Acres/1962/rffl.html

The *rec.food.preserving* FAQ. This work and mine are yin and yang to each other. What I don't cover, Leslie does and vice-versa. Unfortunately, there isn't a good way to get a plain ASCII text version and it hasn't been updated in a while, but it's still chock full of solid, useful information.

http://www.disasterrelief.org/library/prepare

The library of the Disaster Relief Organization. Some really good preparedness information.

| | | |
|---|---|---|
| http://www.fema.gov/library/emfdwtr.htm | | Emergency Food & Water |
| | /famplan.htm | Your Family Disaster Plan |
| | /diskit.htm | Your Family Disaster Supplies Kit |

Three of the many files available on the Federal Emergency Management Agency web site. There's also correspondence classes on a wide range of subjects available, most of them for free. You should also check out the Community Emergency Response Team materials available. There's a tremendous amount of resources and knowledge available here and you've already paid for it, *so use it*.

http://cypress.idir.net/~medintz/surv_faq/surv_faq_index.html

Mike Medintz's web site and it contains the FAQs native to the misc.survivalism newsgroup. Particularly look for the *Threat Assessment FAQ* by Richard DeCastro and the *Water Treatment FAQ* by Patton Turner.

http://www.millennium-ark.net/News_Files/Hollys.html
http://www.ballarat.net.au/~standeyo/News_Files/Hollys.html

These two sites in the States and Australia mirror each other. Created by Holly and Stan Deyo, they offer a great deal of useful food storage information, software, water purification and storage and more. Well worth a look.

http://www.flashnet/~bhphiker/BHP/

The Back Country homepage. All sorts of knowledge relating to the back country. Click on the "distilled wisdom" link to get to the

*rec.backcountry* newsgroup FAQs. One of the most important ones there is the *water treatment FAQ*. It makes a fine complement to Pat Turner's water treatment FAQ.

http://www.homecanning.com

The Bernardin (Altrista) web site. Wet-pack pressure and boiling-water bath canning information.

http://www.danonenewsletter.fr/indexangl.html

This is not Dannon, but Danone, the French yogurt maker. The site has a great deal of information on fermented milk products. It's in English, but French is available as well.

http://countrylife.net

A village of high quality food information about edible wild plants, herbs, grain, milling, baking, fermented milk products and more.

http://www.managingdesire.org/Hesperian/Hesperian.html

Nothing to do with food at all, but a page for ordering the various publications of the Hesperian Foundation, such as *Where There Is No Doctor*, *Where There Is No Dentist* and *A Handbook For Midwives*. In many situations where you might have to seriously rely upon your food storage program these books could surpass the value of their weight in gold. Think seriously about getting them.

http://www.hollowtop.com/finl_html/finl.html

The Food Insects Newsletter site. Just in case you think you'll ever have to.

## E.2 SOFTWARE SOURCES

[I have not used any of these programs myself, but I'm listing them for those who might be interested - editor]

http://www.waltonfeed.com/grain/calc.html

There are two Excel spreadsheets here that can also be imported into Lotus 123, Quattropro or Works For Windows. The first spreadsheet is a nutritional calculator showing the breakdown of 65 nutrients for 167 foods with more being importable. The second spread sheet is a yearly supply calculator.

http://waltonfeed.com/self/plan.html

A nutritional calculator that allows you to enter your food supply and it gives you a daily nutritional printout. This is a smaller, less versatile version of the one from Revelar below, but is less resource intensive and will run on a DOS only machine.

http://www.revelar.com/fsp.html

A more extensive, versatile version of the above program, makes it

much easier to modify for personal use. It also requires at least a 486, Windows and 8mb of Ram. A version for the Mac is available as well.

http://www.beprepared.com (click on free software area)

Offered on the Emergency Essentials web site. The first program is a food planner demo for creating shopping lists and planning recipes for any length of time. The second is a 72 hour preparedness program that will take you through various disasters and how to prepare for them.

http://www.millennium-ark.net/News_Files/Hollys.html
http://www.ballarat.net.au/~standeyo/News_Files/Hollys.html

The U.S. and Australian web sites for Holly and Stan Deyo. They offer food storage calculators similar to the one from Revelar, but with more food items already built in.

## F. ORGANIZATIONS

### F.1 THE CHURCH OF JESUS CHRIST OF LATTER DAY SAINTS

The LDS church, commonly known as the Mormon Church, has long had a welfare program for the benefit of its members in need. Believing that the best way to deal with the problem of needy members is not to have any, the church also strongly encourages its membership to be as self-reliant and self-dependent as possible. To further this end it provides access to church owned cannery facilities and makes large, economical bulk purchases of storage foods to sell at cost to any member with an interest in starting a personal food storage program. Believing that the more self-dependent people there are in general the fewer there will be needy in times of hardship the LDS church also makes those same facilities and supplies accessible to non-church members, or "gentiles", as well.

Most facilities will be located at one of the LDS Bishop's Storehouses located in various places around the country, but some churches will also have their own local facilities. The easiest means of finding out is simply to ask the LDS church member you know. If they don't themselves know, or you don't know any Mormons then a little phone book research will be necessary. Find your nearest local Mormon church and ask about speaking with the local Bishop of the Ward or Relief Society president. Either one of those two individuals will be able to give you the information you seek. Failing any of the above, you can also call the LDS church headquarters in Salt Lake City at 1-800-453-3860 extension 4164.

Or you can write to:

The Church of Jesus Christ
of Latter-Day Saints
Welfare Services
Seventh Floor
50 East North Temple Street
Salt Lake City, Utah 84150

If you find that you have a cannery within striking distance then give them a call. Inquire about available times, what you need to provide and what is not suitable for canning. Be up front and honest with them, they're sincere about allowing non-church members to use their facilities. You'll hardly be the first one to want to talk to them about food storage. Ask for a copy of the cannery guidelines and a price list of what is available. There may also be classes or seminars available. There is a certain degree of variability between the canneries so what is available at one may not be at another.

I've corresponded with many LDS members and have even contacted the LDS headquarters in Salt Lake City to get the official word. Keeping in mind that not every area may have facilities for use and that the family canneries are run by volunteers, they are quite earnest about allowing non-church members to use their facilities. It's worth investigating.

IMPORTANT NOTE: Please do keep in mind that the individuals responsible for the family canneries are all *volunteers* with demands on their time from many areas. Be courteous when speaking with them and, if there are facilities for use, flexible in making arrangements to use them. You will, of course, have to pay for the supplies that you use, cans and lids at the least, and any food products you get from them. With the onset of the millennium the LDS family cannery volunteers are becoming quite busy so be prepared to have to work with their available scheduling. As a general rule they cannot put your food in storage for you. Be ready to pay for your purchases in advance, if necessary. They do not take credit cards and probably cannot make change so take a check along.

Any food products you want to have sealed in cans will need to fall within their guidelines of suitability for that type of packaging. This is for reasons of spoilage control since many types of foods just aren't suitable for just sealing in a container without further processing. If you purchase food products from them, they will already be within those guidelines. A brief treatment of these guidelines may be found below.

### F.1.1 LDS FAMILY CANNERY GUIDELINES

Subject to some variability, the following foods are generally available at the canneries:

| | | |
|---|---|---|
| Apple slices, dried | Macaroni | Rice, white |
| Beans, pinto, pink, great Northern | Milk, non-fat dry | Soup mix |
| | Oats, quick rolled | Spaghetti |
| Carrots, dry | Onions, dry | Sugar, white |
| Cocoa, hot mix | Pudding mix | Wheat berries |
| Flour, white | (chocolate & vanilla) | (hard red winter) |
| Fruit drink mix | | |

You will be able to purchase the necessary cans, oxygen absorbers, boxes and plastic lids for what you want to can.

The following food items are not thought to store well when dry pack canned and generally cannot be put up at the cannery:

| | | |
|---|---|---|
| Baked goods | Egg noodles | Peanut butter |
| Baking powder | Flour, whole wheat | Rice, brown |

| | | |
|---|---|---|
| or soda | Granolas | Spices |
| Barley, pearled | Honey | Sugar, brown |
| Cereal, milled grain | Mixes, if they contain leavening agents | Yeast |
| Coconut | | |
| Cornmeal | Nuts, roasted or raw | |
| Dried meats | Oils or fats | |

Although I am not in complete agreement with the above list, it is workable and will get the job done. Make sure that the food you want to pack has little fat content and strive to make sure it has a low moisture content and you should be OK. For grains, legumes, flours, meals and dried fruits and vegetables do make sure to use the oxygen absorbers. You should not assume the food is insect free. When the packets remove the available oxygen any insect life in the can will either die or at least go into stasis.

## G. FOOD AND EQUIPMENT SUPPLIERS

### G.1 MAIL ORDERING STORAGE FOODS -- WHAT YOU SHOULD KNOW

When it comes to building a food storage program, sooner or later you may want to seriously consider mail ordering at least a part of the foods you want. Even for those of us who try do as much as we can locally there are some things which are not going to be easily available in our areas. To help with this I have included below a list of food and equipment suppliers where just about anything can be found.

Because many do find it necessary or desirable to purchase through mail order I am including a few points which should be considered before shelling out the cash.

1.-- Find out how much the shipping costs are going to be. Grains and legumes are relatively cheap, but weigh a lot when bought by the five or six gallon-bucket. Because of this, shipping charges can sometimes as much as double the actual cost of the product by the time you get it to your door. Adding insult to injury is the $2.00 per round bucket fee UPS is charging. Compare carefully each company's list price and their shipping charges, combined, when deciding who to order from. Saving up for a larger order, or trying to find someone to combine orders with might enable you to make a large enough order to get a price break on shipping. You could also take a vacation in the area of the company's location or swing through the area on the way back from one. If you choose to do this, be certain to call ahead and let them know so they'll have your order ready and waiting for you. The company in the next state may be higher on the list price, but end up being cheaper than having it shipped in from six states away.

2.-- Ask the supplier when your order is going to ship. Some suppliers are way behind in order filling and you could be waiting and waiting. Slowness in shipping is not necessarily a sign of bad business. Some suppliers may drag their feet, but others may be genuinely swamped by the volume of business they are receiving because they have a good product at a fair price. The closer we come to the millennium the worse this problem is going to become.

3.-- How fresh is the product you are ordering? Freshness is what

it's all about when it comes to storage foods. If a food has a five year shelf life in its container then you want as much of those five years to be on your shelf, not the supplier's.

4.-- Be very clear as to how the product you are ordering is packed. Many suppliers offer identical foods packed in several different ways. Be certain the product number you are giving the salesperson is for the product packed in the manner in which you want it.

5.-- What is the head gas analysis? If you are ordering foods packed in a nitrogen flushed oxygen free container (with or without an oxygen absorber packet added) then ask about the laboratory test results that measure the oxygen content of the head gasses in the container. This is of great importance if you are counting on the extra storage life such packaging will give you. There are but a few companies such as Perma Pak, Ready Reserve, and Walton Feed that actually produce packaged storage foods and most dealers only distribute and retail their products. If the dealer can not produce the manufacturer's test data measuring the head gasses of the products they are selling then keep looking.

6.-- If you are purchasing wheat and intend to use it primarily for bread making then be sure to ask about its protein content. The best breads need at least 12% protein and the higher the better. Also take a close look at the weight of the product. One company's five or six gallon bucket of wheat may not weigh the same as another's. The same applies to dehydrated foods such as fruits, vegetables, TVP, etc. Ask about the moisture content of bulk foods which are not already packaged for long term storage. 10% moisture is where you want to be for grains, legumes and most everything else.

7.-- What is the company's damage and return policy? If your carefully packed SuperPails and #10 cans get dented or cracked in shipping you'll need to have them replaced. Most mail order companies will require you to contact the shipper (such as UPS) for a claim number. The shipper may or may not require an inspection so don't destroy any packaging or containers until you know for sure.

Does anyone else know of anything else a person should look out for or ask about when mail ordering storage food?

## G.2 ADDRESSES OF SUPPLIERS

DISCLAIMER: The addresses listed below were either found by me or sent to me by the business owners or interested readers. I make *NO* representation as to their worthiness to do business with. Most of these merchants or manufacturers have been in their field for many years and will be around for many more and are honorable in their dealings. However, there are some businesses that spring up and then disappear and with every update of this work there is at least one or two that I cannot locate from the previous update. The advent of the World Wide Web has only exacerbated this problem. In addition to the precautions mentioned in G.1 above you should take all of the usual precautions in mail or phone ordering.

I have accumulated the following list of names and addresses of

various suppliers of one thing or another relating to food preservation and storage.  They are roughly categorized by type:

STORAGE FOOD MANUFACTURERS:  The actual producers or packagers of storage foods.  Some also do retail sales of their products, but most do not.

FOOD PRESERVATION DEALERS AND SUPPLIERS:  These are businesses dealing with the aspects of food preservation as opposed to storage.  Canning, meat curing, fermented milks, pickling, spices, soybean products, brewing, vintning, etc.

FOOD STORAGE AND PRESERVATION EQUIPMENT MANUFACTURERS:  The actual manufacturers of equipment.  Some will do retail sales and some do not.

DIATOMACEOUS EARTH MANUFACTURERS AND DEALERS:  Self-explanatory.

STORAGE FOOD RETAIL DEALERS:  Retail sales of all of the above.

Naturally, addresses, phone numbers, web sites, etc change over time so if you have more current information than I'm giving here, please be so kind as to let me know.  Additionally, I'm always looking for new companies so if you have some that I don't have I'd like to see those too.  Thanks - ed.

### G.2.1.  STORAGE FOODS MANUFACTURERS

ALPINEAIRE FOODS
Post Office Box 926
Nevada City, California 95959
(800) 322-6325
(916) 272-2624 fax
http://www.alpineairefoods.com/
E-mail:  sales@alpineairefoods.com

Storage food manufacturer.  Shelf stable foods with a long storage life. Many foods that require no cooking.  Also backpacking meals.  No retail sales.  See suppliers list for retail dealers.

FREEZE DRY FOODS, LIMITED
579 Speer Rd
Oakville, Ontario L6K 264 Canada
(905) 844-1471
(905) 844-8140 fax
http://www.freeze-dry.com
E-mail:  info@freeze-dry.com

A Canadian freeze-dried foods manufacturer.  Produces Hardee Camping Foods.  List of dealers on site.  No retail sales.

HARVEST FOODWORKS
445 HWY 29
RR#1
Toledo, Ontario KOE 1YO, Canada
(800) 268-4268
(613) 275-2218
(613) 275-1359 (fax)

http://www.harvest.on.ca
e-mail:  thefolks@harvest.on.ca

A Canadian producer of primarily vegetarian (some have meats) dehydrated and freeze dried foods.  No retail sales, but a links page gives location of dealers.  Ingredients and nutrition information on site.

OREGON FREEZE DRY, INC (Mountain House)
P.O. Box 1048
Albany, OR  97321
(800) 547-0244
(541) 967-6527 fax
(541) 926-6001 international
http://www.ofd.com/mh/index.html
E-mail: mtnhouse@ofd.com

Manufacturer of Mountain House freeze dried foods in pouches and larger cans.  Does not sell direct, but through distributors.  A list of dealers and stocking stores on site.

PERMA-PAK
3999 S. Main St., Suite #S-2
Salt Lake City, UT  84107
(800) 594-8974
(801) 268-3913
(801) 268-4376 fax
http://permapak.com

A major producer of storage foods.  No retail sales.  See retail suppliers list for dealers.

READY RESERVE FOODS
Post Office Box 697
1442 S. Gage
Beaumont, California 92408
(800) 453-2202

Over 100 different dry food products for long term storage.  No retail sales.  Contact company for a list of dealers.

SOPAKCO
P.O. Box 1129
215 South Mullins St
Mullins, South Carolina  29574
(800) 276-9678
(888) 276-9678
(803) 464-0121
(803) 464-2178 fax
http://www.sopakco.com

Manufacturer of military MRE's, their civilian MRE equivalent brand *Camp & Trail* and humanitarian pouch meals.  Some product info on site. No retail sales, but does have dealer contact info.

STAR FOOD PROCESSING, INC.
3444 East Commerce Street
San Antonio, Texas 78220
(800) 882-MEAL

RETAIL SALES.  Fully cooked heat & eat serving trays. Each tray contains 106 ounces of fully cooked, ready to eat products.  Thirty minutes time required to prepare a meal from pantry to the table.  This product is shelf stable and requires no refrigeration or freezing for storage. Normal shelf life is two years.

WALTON FEED,INC
135 North 10th
P.O. Box 307
Montpelier, ID   83254
(800) 269-8563
http://www.waltonfeed.com

RETAIL SALES.  Major manufacturer and supplier of storage foods.  Bulk & N2 packed dehydrated foods, grains/legumes bulk and N2 packed, oxygen absorbers.  Free food storage planning software.  Can labels and head gas analyses of most products available for viewing on site.  Very informative web site.

WORNICK COMPANY, THE (formerly Right Away Foods and Shelf Stable Foods)
200 North First Street
McAllen, TX  78501
(800) 565-4147 (Mil-Spec orders)
(210) 687-9401
(210) 687-7028 fax
http://www.wornick.com

Manufacturer of military MRE's, their civilian MRE equivalent brand *Mil-Spec* and humanitarian pouch meals.  Good information on military and civilian MRE's on their site.  No retail sales.

### G.2.2  FOOD PRESERVATION DEALERS AND SUPPLIERS

Canning, meat curing, food drying, spices, pickling, cultured milk products, soybean products, etc.

ALLIED-KENCO SALES
26 Lyerly St.
Houston, Texas   77022
(800) 356-5189
(713) 691-2935
(713) 691-3250 fax
http://www.alliedkenco.com
E-mail: alliedkenco@msn.com

A butcher supply house specializing in sausage and jerky making supplies and equipment.  Seasoning, sausage casings, meat grinders, sausage stuffers, commercial vacuum sealing machines and more.

CON YEAGER SPICE COMPANY
144 Magill Rd
Zelienople, PA   16063
(800) 222-2460
(412) 452-6171
http://www.nauticom.net/w-pa/yeager.htm
E-mail:  bkrever@fyi.net

Meat curing, smoking, herbs and spices.  Bulk sales.

COOKBOOK SHOPPE, THE
Vickie Tate
302 East 200 North
Manti, Utah 84642
(801) 835-8283

Home Storage & Preparedness Books including Cooking With Home Storage.

CUMBERLAND GENERAL STORE
#1 Highway 68
Crossville, TN   38555
(800) 334-4640
(931) 456-1211 fax
http://www.cumberlandgeneral.com

The rival to Lehman's Hardware.  A good deal of food preservation and storage equipment with the emphasis on non-modern gear.  Can sealers, grain mills, water pumps and a great deal of other non-electrically powered equipment.

DOUBLE SPRINGS HOMEBREW SUPPLY
4697 Double Springs Rd.
Valley Springs, CA  95252
(888) 499-2739
(209) 754-4888
http://www.doublesprings.com/
E-mail:  homebrew@GOLDRUSH.com

Home brewing and vintning supplies of all sorts.  May have oxygen absorbers.  Preservative chemicals.  Many books, including vinegar making.  Vinegar mothers.  A lot of equipment.

GEM CULTURES
30301 Sherwood Rd.
Ft Bragg, CA  95437
(707) 964-2922 (mornings are best time to call, Pacific time)

Fermented food starter cultures such as natto, tempeh, amazake, miso, shoyu, tamari, koji, miso, sourdough and other bread leavens (barm, etc.), fil mjolk, viili, and kefir grains.  Also natural nigari (bitterns) and calcium sulfate (gypsum) as well as a form box for tofu making.

HOME CANNING SUPPLY & SPECIALTIES
P. O. Box 1158
(1815 LaBraya St.)
Ramona, CA 92065
(619) 788-0520 (phone)
(619) 789-4745 (fax)
(800) 354-4070 (orders only)

Home canning and food preservation supplies such as bulk pectin. They offer regular pectin, low-methoxyl pectin without preservatives, and low-meth pectin with preservatives.

KOCH SUPPLIES
1411 West 29th St
Kansas City, Missouri  64108
(800) 456-5624
(816) 753-2150
(816) 561-3286 fax
http://www.kochsupplies.com
E-mail:  koch@kochsupplies.com

Primarily wholesale dealer in meat curing, smoking and sausage making supplies.

LEHMAN'S HARDWARE
P.O. Box 41
Kidron, OH  44636
(330) 857-5757
http://lehmans.com
E-mail:  getinfo@lehmans.com

Not a great deal of food, but a lot of food related equipment, grain mills, can sealers, water pumps, butchering, cheese making, dehydrators, pitters, peelers, etc.  Most of it non-electric. Many books.  Free shipping on many orders.

PENZEYS, LTD. SPICE HOUSE
P.O.Box 933
Muskego,  WI  53150-0933
(414) 679-7207 voice
(414) 679-7878 fax
http://www.penzeys.com/
E-mail:  info@penzeys.com

Herb and spice supply house.  Excellent prices on bulk quantities of herbs and spices.  Good quality and variety.

SAUSAGE MAKER, THE
1500 Clinton St
Building 123
Buffalo, NY 14207-2875
(716) 824-6510 voice

Mail order sausage making, meat curing and smoking supplies, training videos, equipment, etc

STUFFERS SUPPLY COMPANY
22958 Fraser Highway
Langley, B.C.  V2Z 2T9
(604) 534 7374
(604) 534 3089 fax
http://www.harb.net/stuffers
E-mail: bleathem@stuffers.com

A Canadian source of sausage making and meat curing supplies.

### G.2.3.  FOOD STORAGE AND PRESERVATION EQUIPMENT MANUFACTURERS

BERLIN PACKAGING

National Customer Service Center
435 East Algonquin Rd
Arlington Heights, IL  60055
(also regional sites, addresses on web site)
(800) 423-7546
http://www.berlinpackaging.com
E-mail:  info@berlinpackaging.com

Food grade packaging and containers, primarily plastic, but also metal and glass.  They claim no order is too small.

CONSOLIDATED PLASTICS
8181 Darrow Rd
Twinsburg, OH   44087
(800) 362-1000
(216) 425-3900
(216) 425-3333 fax

FDA approved plastic food storage containers, food grade plastic bags, screw off bucket lids and more.  Ask for their Rubbermaid, laboratory/industrial catalogs and bags/packaging/shipping catalogs.

COUNTRY LIVING PRODUCTS
14727 56th Avenue NW
Stanwood, Washington 98292

Manufacturer of the Country Living grain mill.

DESICCARE, INC

| East coast facility | West coast facility |
| --- | --- |
| 211 Industrial Dr | 10600 Shoemaker Ave, Bldg C |
| Richland, MS   39218 | Santa Fe Springs, CA   90670-4026 |
| (888) 932-0405 | (800) 446-6650 |
| (601) 932-0442 fax | (562) 903-2272 |

http://dessicare.com/homeprod.htm
E-mail: desiccant@desiccare.com

Retail sales of pre-packaged and bulk desiccants.

DRYING PANTRY, THE
9756 South Kristin Drive
Sandy, Utah 84070
(801) 571-9115

A non-electric kitchen food dryer.  Uses naturally occurring heat, either from the sun or your homes heating system.  Hangs from a hook to save counter space.  It can also serves as a sprouter.

FREUND CAN COMPANY
155 West 84th St
Chicago, IL   60620-1298
(773) 224-4230 ext 179
(773) 224-8812 fax
http://www.freundcan.com

Metal, glass and plastic containers.  Can sealers of several sorts.  Claims will sell any quantity.

GLITCHPROOF.COM
3171 Green Valley Rd #11
Birmingham, AL 35243
(205) 302-0706
(205) 969-9356
http://www.glitchproof.com
E-mail:  info@glitchproof.com

No food, but carries kits and products for do-it-yourself food storage. Buckets, lids, oxygen absorbers, Mylar and poly liner bags, 55 gallon food-safe drum liners, and other packaging items.

LIFE SPROUTS
Post Office Box 150
Paradise, Utah 84328-0150
(800) 241-1516

Manufactures the Sprout Master Sprouter and carries organic sprouting seeds.  Also markets recipe books, food storage.

UNITED STATES PLASTICS
1390 Neubrecht Rd
Lima, OH   45801
(800) 537-9724
(419) 228-5034 fax
http://www.usplastic.com
E-mail:  usp@usplastics.com

FDA approved plastic food storage containers, food grade plastic bags, screw off bucket lids and more.

WELLS CAN COMPANY, LTD.
8705 Government St
Burnaby, British Columbia V3N 4G9 Canada
(604) 420-0959
(604) 420-0975 fax
http://www.cobra-net/wellscan/canning.html
E-mail: wellscan@lightspeed.bc.ca

A Canadian manufacturer of pressure canners & cookers, can sealers, metal cans, canning jars, plastic and metal buckets and vacuum sealers. Retail sales.

### G.2.4  DIATOMACEOUS EARTH MANUFACTURERS AND DEALERS

ALL GONE!
Phone: 800-373-3423
E-mail allgone1@vero.com

Diatomaceous earth

DIATECT CORPORATION
c/o Gordon Dill 410 E. 48th St Holland, MI 49423

Diatomaceous earth

FOSSIL SHELL SUPPLY COMPANY

P.O. Box 50225 Amarillo TX 79159
(800) 370-9920
(806) 355-4236 voice
(806) 351-0777 fax
http://www.webtex.com/webtex/com/fssc /
E-mail jandj@arn.net

Diatomaceous earth

NECESSARY ORGANICS, INC
One Nature's Way
New Castle, VA  24127-0305

Concern brand diatomaceous earth.  This is the brand I've been buying.

PLANET NATURAL
1612 Gold Ave
P.O. Box 3146
Bozeman, MT  59772
(800) 289-6656
(406) 587-0223 fax
http://www.webcom/ecostore/index.html
E-mail:  ecostore@webcom.com

A very green dealer.  The DE is in the Soaps, Oils and More directory.

### G.2.5 STORAGE FOOD RETAIL DEALERS

AMERICAN FREEDOM NETWORK, THE
P.O. Box 1750
Johnstown, CO  80534
(800) 205-6245 orders
http://www.amerifree.com/index.htm
E-mail: comments@amerifree.com

Mainstay Emergency Ration bars, Country Living grain mill, Katadyn water filters.  Pre-packaged storage foods, including organic.

B&A PRODUCTS
Rt 1 Box 100
Bunch, OK  74931-9705
(918) 696-5998
(918) 696-5999 fax
http://www.baproducts.com
E-mail:  Byron@baproducts.com

Water filters, Ready Reserve, Alpineaire foods and Heater Meals.

BACK TO BASICS (KATHLEEN LAMONT)
P.O. Box 1138
Waynesville, NC  28786
(704) 452-2866
http://www.dnet.net/~basics
E-mail:  basics@dnet.net

Many good books, food dehydrator, Tilia vacuum sealer, video taped food storage courses.  Lamont lectures at some preparedness expos.

BEST PRICES STORABLE FOODS by Bruce Hopkins
1737 Cascade St
Mesquite (Dallas) Texas  75149
(972) 288-0262 in the p.m.
(972) 288-4610
(214) 742-7777 weekdays in the a.m.
http://web2.airmail.net/foodstr2/
E-mail:  foodstr2@airmail.net

Pre-packaged dehydrated foods, bulk foods, grains, legumes, and grain mills.  Mylar bags, oxygen absorbers, containers and DE. Mountain House freeze dried foods.  Organic foods.

COUNTRYSIDE GRANARY
P.O. Box 701
Hull, Iowa  51239
(888) 435-3948
(712) 439-1861
Web site & E-mail coming.

Grains, lequmes, dry milk and other bulk foods in bags and 6 gallon SuperPails.  Sprouting seeds.  Diatomaceous earth, oxygen absorbers and food-grade 55 gallon drums.

CSIN
P.O. Box 538
Libby, MT  59923
(406) 293-8121 9a.m.-9p.m. MST
http://www.kootenet.net/csin/index.htm
E-mail:  CSIN@kootenet.net

Grain mills, bulk and nitrogen packed (buckets & cans) grains, legumes, dehydrated and freeze dried foods, sprouting seeds. Oxygen absorbers and Mylar bags.  $100 minimum order.

EMERGENCY ESSENTIALS
National Catalog Sales Office
165 S. Mountain Way Drive
Orem, Utah 84058-5119
(801) 222-9596
(800) 999-1863 Toll Free Order Line
http://www.beprepared.com
E-mail: webmaster@beprepared.com

A major preparedness retailer.  Storage foods of all types, MRE's, water purifiers, storage containers, grain mills and other food equipment. Excellent costs on shipping.  Free preparedness software.

EMERGENCY FOOD STORAGE
322 Buckingham
Prescott, AZ  86303
(800) 414-9324
http://www.northlink.com/~gwiatt
E-mail:  permapak@usa.net

A PermaPak foods distributor, pre-packaged food plans.

EPICENTER, THE (EMERGENCY PREPAREDNESS INFORMATION CENTER)
6523 California Ave SW, #161
Seattle, WA 98136
(206) 937-5658 voice/fax
http://TheEpicenter.com
e-mail: bjnelson@TheEpicenter.com

Heater Meals, Datrex ration bars and MREs.  Water filters.

FC SURPLUS
1712 Dundas St. E.
London, Ontario   N5W 3E1 Canada
(519) 451-0246 voice & fax
(519) 451-9341 fax, if above line is busy.
http://www.fcsurplus.com/mltryfd.htm
E-mail:  question@fcsurplus.com

Canadian "Freddy Chef" MREs and other surplus related items, primarily Canadian or British.

HAPPY HOVEL FOODS
P.O. Box 781
Yelm, WA 98597
(800) 637-7772
(360) 458-4445
(360) 458-7977 fax
http://www.wwmagic.com/haphov
e-mail: haphov@seanet.com

Pre-packaged foods, bulk grains, legumes and dehydrated foods. MRE's, freeze dried foods, grain mills.

HOMESTEAD PRODUCTS
Contact via phone or e-mail for postal address
(541) 688-9263
(541) 688-9775 fax
http://www.teleport.com/~dany/mill
E-mail:  dany@teleport.com

Several grain mills, Katadyn water filters and Aladdin lamps.

J&K ENTERPRISES
519 Griffith Ave
Terrell, TX  75160
http://www.hischaracter.com/foods.htm
E-mail:  jseitz@hischaracter.com

Pre-packaged storage foods, bulk grains, legumes, dehydrated foods organics, Alpineaire, sprouting seeds.  Oxygen absorbers, grain mills.

JOSEPH PROJECT, THE
P.O. Box 6701
Lubbock, TX   7493-6701
No phone listed.
http://corporate.odyssey1.net/josephproject/
E-mail:  JosephProject@odsy.net

Bulk dehydrated foods.

LAKERIDGE FOOD STORAGE
896 E. 640 N.
Orem, Utah  84097
(801) 221-8207 fax
(800) 336-7127
http://www.shopsite.com/lfs
E-mail: lfsfood@ix.netcom.com

Pre-packaged long term storage foods, bulk grains, legumes, organic foods, sprouting seeds, dehydrated foods and some freeze-dried.  Grain mills.

LIVE OAK FARMS
(877) 878-4867
(405) 794-7365
The site did not list a postal address
http://www.universalweb.com/food/index.htm
E-mail: ron@universalweb.com

Pre-packaged foods, bulk foods, MRE's, sprouting seeds.  Grain mills and other equipment.

MAJOR SURPLUS
435 W. Alondra Boulevard
Gardena, California 90248
(800) 441-8855
(310) 324-6909 fax
http://majorsurplusnsurival.com
E-mail:  info@majorsurplusnsurvival.com

MRE's and some food/water storage containers.

MEYERS CUSTOM SUPPLY
P.O.Box 212
Cassel, CA  96016
(800) 451-6105
(530) 335-4320
http://www.C-zone.net/meyerscs/mcs
E-mail:  mcs@C-zone.net

Alpineaire foods, civilian MREs.

MILLENNIUM FOOD STORES
726 North 1890 West #34
P.O. Box 50597
Provo, UT  84605
(800) 500-9893
(801) 375-2264
(801) 356-1523 fax
E-Mail:  food@itsnet.com
http://www.millenniumfoods.com

Dehydrated & freeze-dried foods in #10 cans, and Mylar lined buckets. Some bulk foods.

NITRO-PAK PREPAREDNESS CENTER
151 N. Main Street

Heber City, Utah 84032
(800) 866-4876
(888) 648-7672 toll free fax
http://www.nitro-pak.com (It's been under construction for a long while)
E-mail:  nitropak@shadowlink.net

Pre-packaged and bulk dehydrated, freeze-dried, storage foods. Datrex and Mainstay ration bars.  Mountain House and Alpineaire foods and civilian MREs.  Water storage containers and filters. Grain mills, #10 can sealer.  Oxygen absorbers and Mylar bags..

PONDEROSA SPORTS & MERCANTILE, INC.
6854 Highway 55
Horseshoe Bend, Idaho   83629
(208) 793-3121
(208) 793-3133 fax
E-mail:  ponder@micron.net

Preparedness food, equipment and supplies. MRE's, Mountain House freeze dried foods, Heatermeals, BFM (Balanced Food Mix),  26 page catalog, send $2.

PRODUCT SOURCE INTERNATIONAL
255 East 400 South, Ste 150
Salt Lake City, Utah   84111
(801) 531-8996 voice
(801) 328-1243 fax
http://www.downtown-web.com/psi
E-mail: psiusa@aros.net

Pre-packaged and bulk long term storage foods, books, grain mills, containers (empty #10 cans for home use).  Oxygen absorbers (in emergency preparedness section).

PROVISIONS 2000, INC
2271 W 12th Lane
Yuma, AZ   85364
(520) 329-7158
http://home.sprynet.com/sprynet/prov2000/main.htm
E-mail: prov2000@sprynet.com

Alpineaire gourmet reserves & Canadian military MREs.

SAFE TREK
90 Safe Trek Place
Bozeman, MT   59718
(406) 587-5571
(406) 586-4842 fax
(800) 424-7870
http://www.safetrek.com
E-mail: Sales@avicom.net

Alpineaire pre-packaged foods, their own cannery line as well. Grain mills, books,  Oxygen absorbers.

SECURE FUTURE
640 Bailey Rd, #128
Pittsburgh, CA   94565

http://www.securefuture.com
E-mail: questions@securefuture.com

N2 packed dehydrated foods (Ready Reserve), Pre-packaged food plans, grain mills.

SHERRY'S STOREHOUSE
P.O. Box 1507
Merlin, OR 97532
(541) 471-7859 days
(541) 660-8267 evenings
(800) 662-0137 fax
http://www.homezen.com/sherstor/sherstor.html
E-mail:  none listed.

Grains, legumes, dehydrated, freeze dried, organic bulk and nitrogen packed foods (buckets and cans), sprouting seeds, Mainstay ration bars. Oxygen absorbers, Mylar bags, #10 cans and grain mills.

SOUTH SUMMIT CORPORATION
P.O. Box 851293
Richardson, TX   75085
(972) 495-5270 voice
(972) 495-9579 fax
http://www.southsummit.com
E-mail: southsummit@topher.net

Provident Pantry long term storage foods, MRE's, water storage, filters and containers, ration bars, freeze dried foods (multiple manufacturer's), plastic food storage buckets.

STOREHOUSE PRODUCTS
Post Office Box 690021
San Antonio Texas 78269
(210) 690-7632
http://www.dcci.com/DCCI/storehouse.html
E-mail:  deyer@dcci.com

A Texas distributor providing a complete line of dehydrated foods, grain mills, water purification systems. Call or write for a free catalogue.

SURVIVAL CENTER, THE
19223 Cook Road
P.O. Box 234
McKenna, Washington 98558
(360) 458-6778 voice
(360) 458-6868 fax
(800) 321-2900 orders only
http://www.zyz.com/survivalcenter
E-mail: sales@survivalcenter.com

A lot of books, not all of them useful.  Pre-packaged food plans. Mountains House freeze dried foods in pouches and cans.  MRE's. Grain mills. For catalog send $2.00.

WHEAT MONTANA FARMS & BAKERY
10778 Hwy 287
Three Forks, MT   59752

(406) 285-3614
(406) 285-3749 fax
(800) 535-2798 (small quantity UPS orders)
http://www.wheatmt.com

Hard red wheat, hard white wheat, organic wheat, other bulk and packaged grains, pinto beans.  Empty buckets and lids.  Small qty and bulk flours as well.

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Please direct orders, comments, questions, contributions and criticisms to:  athagan@sprintmail.com

Postal mail address:
A.T. Hagan
P.O. Box 140008
Gainesville, Fl  32614-0008